CHEMICAL & METALLURGICAL ENGINEERING

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S. D. KIRKPATRICK
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Managing Editor

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Market Editor

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Associate Editor

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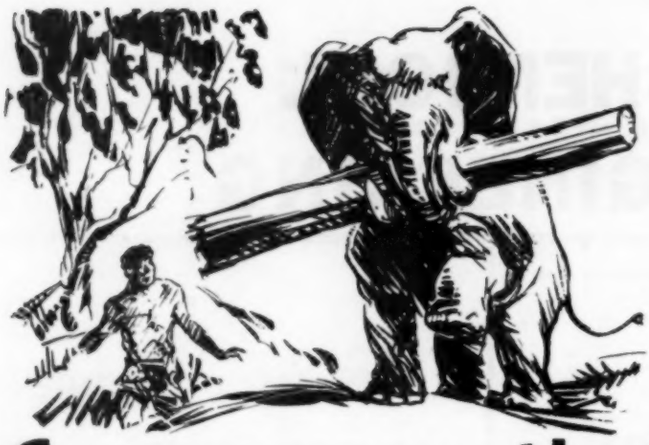

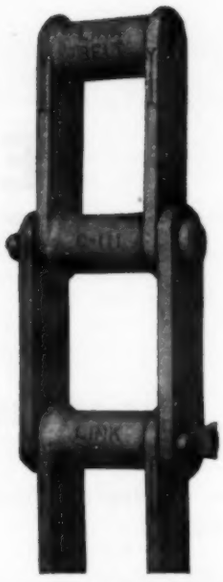

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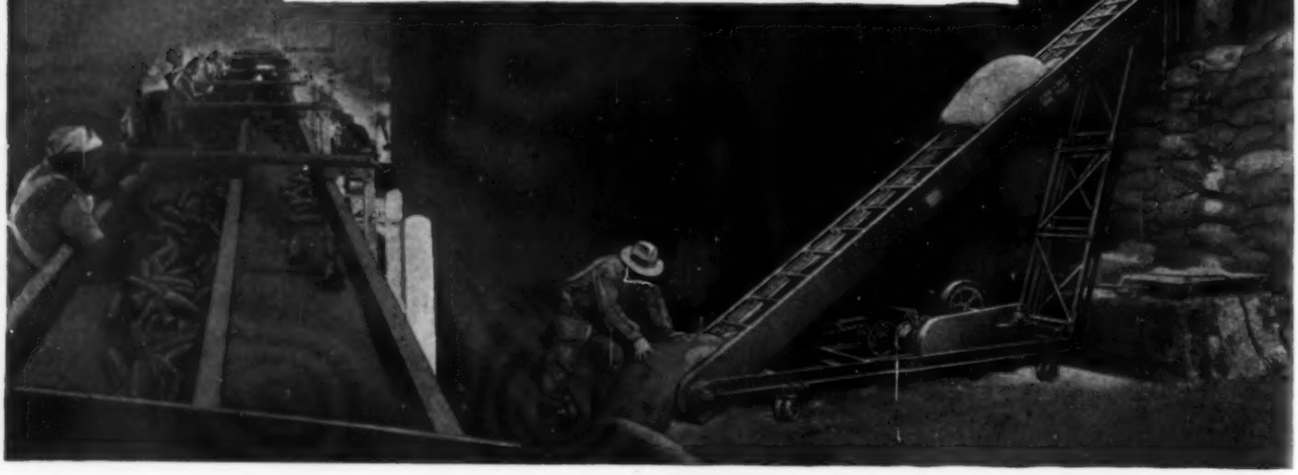

CHEMICAL & METALLURGICAL ENGINEERING

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S. D. KIRKPATRICK, Editor

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MORE BURDENS FOR MANAGEMENT?

CONGRESS left on Industry's doorstep two little foundlings that are looking for loving support and adoption. No one, least of all a kind-hearted employer, could turn them away, especially when we have heard so much lately about industry's social responsibilities in the more abundant life. They are indeed charming babies—Social Security, who couldn't harm anyone, and Little Labor Relations-Law, who is just a mischievous youngster hardly big enough to throw stones at your factory windows. Why shouldn't we adopt these little fellows into the family circle? It may cost some money to support them, but that isn't half as important as how they are going to get along with the rest of the family. What's going to happen to our own children?

Some chemical and process-industry companies, you know, have long had their own pension plans, and retirement programs. Others have been moving as rapidly in that direction as their resources would permit. Now comes along Miss Social Security—almost like the good little fairy to wave her magic wand and provide something for everyone. Why should we continue to set aside money for less provident employees? Can't all this be turned over to the Government—now that Congress has become imbued with the idea that the state is responsible for the individual?

But the real trouble-maker is likely to be the bad little boy who seems to have been born just for the purpose of starting a fight between employer and employee. His parents, whoever they were, apparently never believed that these two have identically the same interests—that they can and in most industries have lived peacefully together. Why must we start out now on the assumption that they are antagonistic? Why must the employer be placed in a strait-jacket, so bound in by definitions and legal restrictions as to make it impossible to deal on a fair and equal basis with his employees? Why, again, must industry throw overboard many of the works councils and employee representation plans that have just begun to prove their tremendous value in bringing about true understanding of motives and mutual respect between management and men?

Perhaps we have erred in referring thus lightly to problems of gravest importance which management must face, competently and courageously, during the next few months. Whether we like it or not, it is true that these two new laws have invaded the family circle. One of them, at any rate, has stepped in between employer and employee and has put new obstacles in the path of amicable industrial relations. No conscientious employer can quarrel with the general purpose of these two laws and with some of their provisions. Others may be amended by a later Congress or even set aside by the court, but in the meantime, they are the laws of the land and must be obeyed.

Industry thus has its job cut out for it and as L. C. Morrow, editor of *Factory Management and Maintenance* recently told the annual Silver Bay Conference on Industrial Relations, that job is largely one of education. "This situation," he said, "puts a triple burden upon the employer—the burden of educating himself, of educating his employees, and of doing his fair share in placing practical economic facts and industry statistics before the Government." This whole educational process can be most effective in industries where there is the highest type of personnel, with a broad, constructive viewpoint on employer-employee problems. To management in chemical engineering enterprises, this situation may yet prove an opportunity for a new type of leadership in human relations.

From an EDITORIAL Viewpoint

A Living Monument To a Great Pioneer

INDEED typical of the whole life interest of the man is the late Dr. Arthur D. Little's bequest that the industrial research firm which bears his name should eventually become a part of Massachusetts Institute of Technology. Long years of close association were clearly reflected in the growth and development of both institutions. The industrial firm through fifty years of Dr. Little's own efforts and those of his several partners pioneered in carrying chemical engineering and research to industry throughout the world. The educational institution, again largely through Dr. Little's efforts and those of these same partners, pioneered in the formulation and organization of a chemical engineering curriculum that has long been held an international standard. Dr. Little's heart and spirit were in both. It is fitting that they should continue their independent service to industry and education in such a way as to perpetuate and honor the memory of a great and noble leader of the chemical engineering profession.

New Styles Set For Lobbying

LOBBYING in Washington is changing in type and style. There is a growing conviction with Congress that the old under-cover type of lobbyist is a public enemy. Direct, out-in-the-open representation, therefore, becomes the vogue and is indeed, as always, the most effective type.

Because chemical industry makes many munitions there will be increased need for consideration of ways in which effectively to bring information from industry to Congressmen with respect to specific bills of international implication. Thus far chemical industries have been quite successful in working under the new style procedure. Despite the foolish fiasco of the Ethiopian petroleum-grant, which is not going to be helpful to any branch of big business, most of the process industries are highly regarded in Washington when they speak as to the needs of industry, the possibilities in preparedness, and the opportunities for legitimate foreign trade in their commodities.

It is rather fortunate that none of the important chemical companies maintains Washington offices which have any appearance of being lobby centers. When any of these companies has something to say to Congressmen they select the appropriate man and send him to Washington with his message. They are frank as to whom they represent and as to what they want and generally quite convincing as to why they are entitled to their wishes. This is as it should be. It is to be hoped that all executives of process industry, when they have to do with legislative or administrative questions of this sort, will use the maximum of discretion so that not only their effectiveness may be maintained, but also that the reputation of the industry as a whole may be safeguarded.

Social Security And Industrial Pensions

AS RECENTLY PASSED by Congress and signed by the President, the Social Security Act is intended among other things to guarantee some means of support to the man and woman too old to obtain employment any longer. The maximum amount of the pension will be $85 per month, a sum sufficiently large to be of assistance to many former workers, but obviously too small to guarantee to the average chemical engineer a living of the standard to which he is accustomed. It is earnestly to be hoped that the passage of this act will not tend to put an end to already established pension schemes of the chemical manufacturers that now adequately provide for pensions more in keeping with the needs of the engineer, but on the other hand will act as an incentive to all manufacturers to supplement the Federal act with one of their own that will care adequately for the retirement of employees in the higher salaried brackets.

Single Fuel Policy Should Be Fixed First

INTER-FUEL competition is today just as important as inter-company competition within any fuel market. Yet there is no agency adequately working among the many "planners" of Washington to formulate a single sound fuel policy for the nation.

Congress recently considered separate bills for the regulation of the coal and the petroleum industries, passing only the former. Already we have independent agencies dealing with power (Federal Power Commission) and pipeline handling of fuels (Interstate Commerce Commission). Each agency, existent and proposed, has certain distinct functions which do not overlap. Hence, there may be some excuse for several agencies; but more important to the country than mere detail of administration is the question of formulating a sound set of principles to govern production and interstate marketing of *all* of these energy sources in their inter-competitive situation.

In the first place Washington should be made to see that there should be only one fundamental fact-gathering agency. Only when *all* of the facts bearing on energy utilization are formulated in a single, comprehensive program will administration be soundly planned. Then, if for administrative reasons there must be sepa-

rate agencies to police various divisions of the energy business, these policemen could be required at the least to work by a single set of principles, based on the adequate, effective, factual survey.

Chemical engineers are fully aware of the complications in the energy business. They are responsible for much of the design of equipment for fuel processing, petroleum refineries, byproduct coke works, and natural-gas-treating plants. They, too, are responsible for much of the fuel selection of the outstanding process industries. Because of this informed position they should exert every influence at their command to ensure that separate conflicting policies for each type of energy or fuel are not to be formulated in Washington. Chemical industry cannot be benefited by such a hodge-podge of plans. Its influence should be promptly exerted in the direction of simplification and coordinated study.

Back to the Good Old Days?

WERE ONE to believe too implicitly the current liquor advertisements, the inescapable conclusion would be that the distilling industry is intent on rapidly getting back to the old rule-of-thumb days of secret processes and family formulas. More and more have the distillers advertised their products as being made under exactly the same conditions (and sometimes by the same personnel!) as in the pre-prohibition era. It is our observation, however, that these conditions exist more in the public prints than in the actual plants. The good old jovial distillers are disappearing and their places are being taken by young chemical engineers. Secrecy is being replaced by accuracy. Scientific blending takes the place of the old family formulas and the human element gives way to automatic control in mashing, cooking and distillation.

Even the buildings reflect the changes that are under way. The once universal wooden silos and bins are fast disappearing and fireproof, sprinkler-protected buildings, with cement and steel storage facilities, are becoming standard construction. Pneumatic conveyors carry the grain to and from storage. Automatic scales weigh accurately the meal that goes to the cookers and the mashing tubs—thus insuring uniform blending. Better extraction is obtained with the improved cookers—in effect, modern autoclaves provided with temperature and pressure recorders, automatic steam-control devices and improved vacuum pumps. Steel fermenters with closed tops and cooling coils are replacing the old open-top wooden fermenters. Better control of fermentation eliminates the necessity for lime washing, permits quick steam sterilization, greater yields of alcohol and the profitable recovery of CO_2—all advantages not "in the wood."

Probably the most radical change in the distilling industry—and one that isn't talked too much about in the liquor advertisements—is the progress in the development of the quick-aging process. Aging in barrels at an elevated temperature, or with charred white oak chips, or accelerated by means of ozone, electrolysis, electric heating or the use of permanganate—these and other schemes—such as the controlled storage of alcohol of definite fusel oil content—are all being used, with their proponents ready to prove their special advantages. Actual sales of the product are, of course, the best criteria of the superiority of the processes and it is interesting to note the way consumption has been mounting for some of the popular brands of quickly-aged whiskies. At the same time an inventory of the industry will show that most of the established distillers are constantly adding to their warehouse stocks, seemingly convinced that natural aging in barrels under scientifically controlled conditions is still the best and surest road to success.

So goes the conflict between the old and the new in this new-old industry. Despite what one reads in the beautiful and humanly interesting advertisements, there is reason to believe that technical progress is being made and that the chemical engineer is playing an increasingly important rôle in the process.

Thoughts on Going Back to School

AS THE YOUNGSTERS start off this month to school and college, many a dad will be secretly wishing he might go along. There have been a lot of changes since the days when many of us studied our chemistry and chemical engineering. Take, for example, this whole field of organic chemical industry, and what is being accomplished through a systematic approach via the unit processes of organic synthesis. Here, if we read the signs aright, lie some of the most promising of new opportunities for the future chemical engineer. Certainly he will have his hands full as he translates the mounting flood of organic research results into profitable large-scale processes. Here the newer concepts and practices in organic chemical engineering are going to prove invaluable.

But how are we going to find the time and opportunity to master this newer technique? Self education is sometimes difficult and painfully slow. What may be a better way, perhaps, is in the extension courses for graduate study now being offered in a number of institutions, particularly in the larger cities. Brooklyn Polytechnic Institute, under the veteran leadership of Professor Olsen, has arranged a series of weekly lectures on the unit processes of organic synthesis to be given by a group of outstanding industrial specialists (see *Chem. & Met.* July, p. 396). Chicago's Armour Institute moves into new and more desirable quarters with a definite intention of extending its work in adult education to meet the needs of the technical man who has "become rusty in some of the basic essentials of engineering." No doubt similar courses are being offered in other cities of the country. If you are interested, now would seem to be a good time to find out about these courses and to get started on your personal campaign against professional obsolescence.

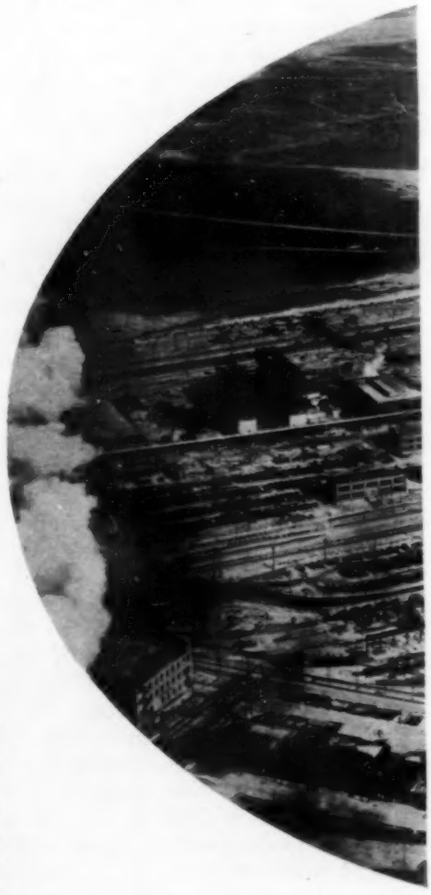
WHAT ARE THE ACHIEVEMENTS OF CHEMICAL ENGINEERING?

EDITORIAL STAFF REVIEW

What company in the process industries of the United States has contributed the most meritorious advance to chemical engineering during the past two years? What is the nature and extent of that achievement? And, in what degree have chemical engineers participated in the affairs of the company that has been responsible for this outstanding advance? These are some of the questions that must be answered within the month by the committee of engineers and industrialists who are to decide the second "Chem. & Met." Award for Chemical Engineering Achievement. The brief rules and regulations governing that award appeared on p. 191 of our April, 1935, issue.

The committee consists of Albert E. Marshall, chairman, consulting chemical engineer and president of the American Institute of Chemical Engineers; Charles E. Adams, president of Air Reduction Co.; Charles Belknap, president of the Merrimac Chemical Co. and chairman of the executive committee of the Manufacturing Chemists' Association; Harry A. Curtis, chief chemical engineer, Tennessee Valley Authority and vice-president, American Institute of Chemical Engineers; John V. N. Dorr, president, the Dorr Co., Inc.; the late Arthur D. Little; Walter A. Schmidt, president, Western Precipitation Co.; M. C. Whitaker, vice-president, American Cyanamid Co.; and Alfred H. White, professor and head of the department of chemical engineering, University of Michigan. The editor of "Chem. & Met." serves as secretary but without voting power.

THESE past two busy years of reconstruction and recovery have been unusually productive of chemical engineering achievements. Many of them had their origin in research begun during or even before the depression, but if, in the opinion of the committee, they have come into fruition since December, 1933, they are eligible for the *Chem. & Met.* Award. A systematic review of some of the outstanding chemical engineering achievements and developments by different companies in the process industries was begun in an editorial in the May issue of *Chem. & Met.* (see p. 243) which cited the important advances in petroleum refining resulting in the solvent-extraction processes of producing lubricating oils. This was followed in June (see p. 299) with an exposition of the developmental work on the manufacture of low-cost phosphoric acid by the electric-furnace, blast-furnace and improved wet acid processes. Cheaper acetic acid, a significant goal in the organic chemical industries, has called forth an interesting group of competing processes and sources which were reviewed in July. (see p. 355). The purpose of the present summary is to highlight other trends and developments in fields that have been especially active during the period under consideration. We have attempted to be reasonably comprehensive but if we have missed any important achievements in chemical engineering, the reader is invited and urged to bring these to the attention of the Award Committee.



Carbide & Carbon Chemicals Corp., winner of the first *Chem. & Met.* Award for Chemical Engineering Achievement, has added significantly to its list of new synthetic organic chemicals. It has found a greater market for its octyl alcohol, acetate and aldehyde and has also introduced such new products as methyl-amyl ketone, methyl-aceto acetate, ethyl-butyl alcohol, and its acetates, aceto-acetanilide, butyric anhydride, ethyl silicate and the polyethylene amines. Furthermore, this company has recently completed at Whiting, Ind. a large new plant which will be devoted exclusively to the manufacture of synthetic organic chemicals. Production of both ethyl alcohol and acetone are already under way to supply consumers in the middlewestern states.

Blowing Bromine From the Sea

One of the first and most interesting of the major chemical engineering developments to come to fruition during the past two years was the successful, large-scale recovery of bromine from sea water. The unique plant of the Ethyl-Dow Chemical Co. at Kure Beach, N. C., was built late in 1933 and went into commercial production early in 1934. The factors leading to the selection of this unusual plant site and the background of research and development on the part of the chemists and engineers of the Dow Chemical Co. were described in *Chem. & Met.*, August, 1934, pp. 402-4. Since that time the plant has established a splendid record of performance with complete vindication of its daring and pioneering technology. Originally designed to produce a half million pounds of bromine per month, the output has exceeded that amount by at least 20 per cent for quite some time. With a very slight additional outlay for minor changes and a relatively small amount of new equipment, this plant could be brought up to double its original capacity.

Chemical engineering carries on! Carbide and Carbon Chemicals Corp., winner of the first Award for Chemical Engineering Achievement, continues its remarkable progress in building a synthetic aliphatic chemicals industry in this country. Here is the recently completed plant at Whiting, Indiana, making new products from hydrocarbons

The Ethyl-Dow achievement has been more widely publicized than others of the Dow group, but the engineering thoroughness and the independence of research with which it was developed are indeed typical of the parent organization at Midland, Mich. There since the early days of this company, the emphasis has been on group rather than individual effort and attainment. The organization founded by the late Dr. Herbert H. Dow, has always distinguished itself by a remarkable coordination of research, engineering, sales and commercial developments. The extent to which chemical engineers have participated in all phases of the activities of the Dow Chemical Co. is a matter of record in the industry.

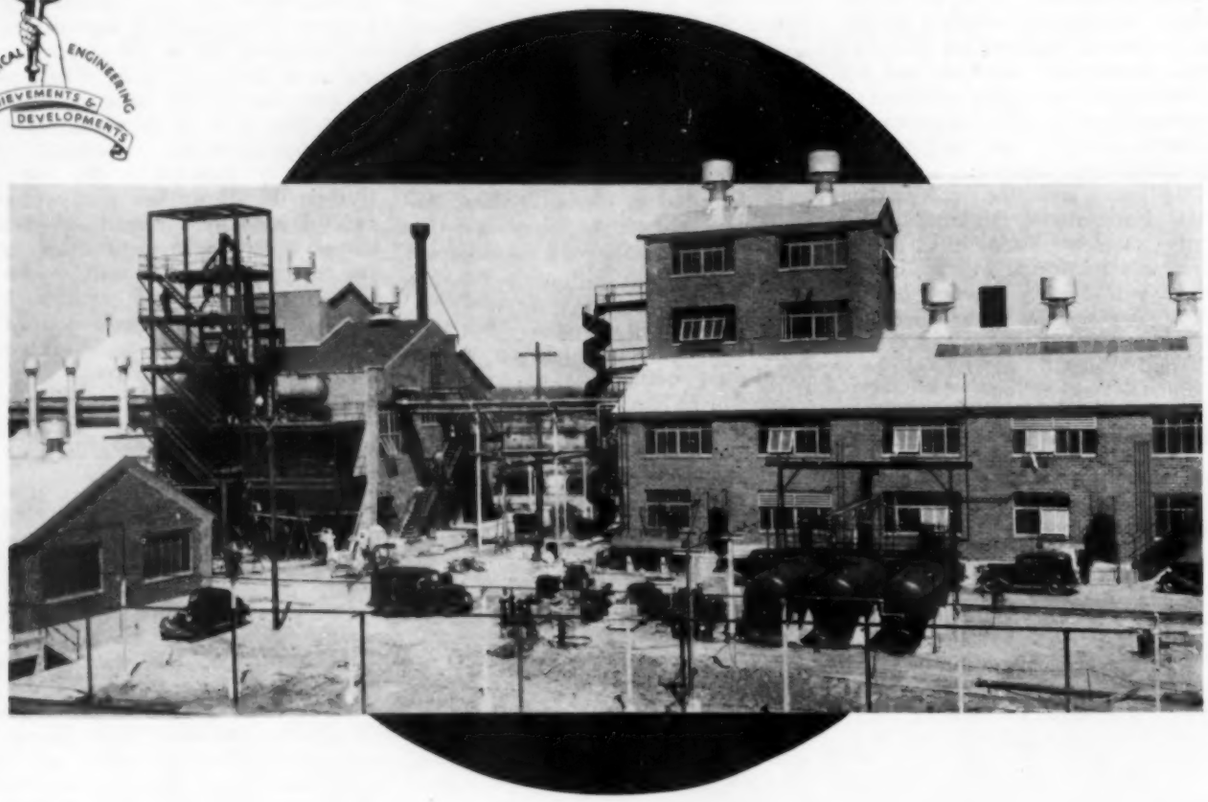
Synthetic Rubber Climaxes Dyestuff Development

Another of the more widely heralded achievements of recent months is, of course, the production of DuPrene the synthetic rubber made by the controlled polymerization of chloroprene from acetylene. Although the chemists and engineers of the E. I. duPont de Nemours & Co., Inc., first announced the results of their extensive investigations on Nov. 2, 1931, this development has come to fruition only during the past year. The new plant on which construction was recently completed is shown in an accompanying illustration.

The award of the Nicholls medal to Father J. A. Nieuwland by the N. Y. Section of the American Chemical Society, not only indicated the chemical profession's high regard for this achievement but also brought out clearly and for the first time the cooperative group effort on the part of duPont's chemical engineers which was responsible for translating interesting and academic theory into large-scale commercial production. DuPrene's unique points of superiority over the natural product quickly opened up an increasing market for it despite higher costs.

While such a development as DuPrene serves to dramatize the activities of a resourceful and productive group in chemical industry, we are apt to lose sight of the tremendous background of company effort and achievement that has made possible all of this progress. From that same source has sprung, during recent years, such important and varied achievements as the successful commercial synthesis of camphor, the increasingly large-scale production of tetraethyl lead, the new refrigerants based on fluorine, the anti-oxidants and inhibitors used in the rubber and petroleum industries, as well as the wide variety of solvents, resins, plasticizers, and emulsifiers that are literally making over the paint and varnish industry.

In speaking before a recent meeting



New plant unit of duPont company where synthetic rubber "DuPrene" is being made, culminating many years of research in university, as well as industrial laboratories. This achievement has come to fruition only in the past two years as duPont chemical engineers have translated theory into successful production

of dyeworks foremen at the Deepwater plant in New Jersey, W. S. Carpenter, Jr., vice-president of the duPont company, revealed some of the extremely interesting and significant history of the early years of his company's operations in this field. His address was entitled "A Challenge That Was Accepted!" but few people outside of the industry would have guessed at the cost of that acceptance. Mr. Carpenter said, "At the end of the first five years, the duPont company had invested in this industry (dyestuffs and synthetic organic chemicals), in plants and working capital, $22,000,000 and in addition to that had suffered operating losses to the extent of $18,000,000, making to that date, a total outlay of $40,000,000 without a cent of profit. The investment has been increased in large measure in the thirteen years since that time." Has it all been worthwhile? Have the 60,000 to 70,000 stockholders whose money was so ventured, had a fair return on that investment? More important, has the American public been benefited by an investment which has "made more secure the continued operation of those industries which employ millions of men and which depend for their continuous operation upon the products of the synthetic organic chemicals industries?" No one need look to Washington for an answer to those questions. DuPont chemical engineers, the largest corporate group within the profession, have made history of which all may well be proud.

Petroleum Technology Advances

Previous editorials in *Chem. & Met.* have pointed out that among process industries, petroleum refining is undoubtedly the largest single employer of chemical engineers. It is only natural, therefore, that this field should have been productive of a most impressive array of important chemical engineering achievements and developments. Those having to do with solvent extraction have already been discussed (see *Chem. & Met.*, May, 1935, p. 243), but it is desirable to recall that other processes have also contributed important improvements in the manufacture and quality of lubricating oils. The asphalt precipitation process which largely, if not completely, removes the need for sulphuric acid in refining other than Pennsylvanian oils is one of these. Here the Union Oil Co. of California made a notable contribution as a result of fundamental research carried through to commercial success by group effort. Lately it has combined and pooled its patented processes with those of the Standard companies of New Jersey and Indiana and the M. W. Kellogg Co. The Atlantic Refining Co. was also a pioneer in this work. Consideration must be given to the new dewaxing processes employing diluents other than the time-honored naphtha and thereby achieving lower pour-test oils without such large refrigeration costs. The rapidly increasing use of propane for this purpose has been greatly stimulated by the same JUIK (Jersey, Union, Indiana, Kellogg) group previously mentioned.

For the successful application of the hydrogenation process to petroleum re-

fining and for the essential development of a process for producing hydrogen cheaply, a great deal of credit must go to the Standard Oil Co. (N. J.) To be sure, the first plant went into operation early in 1930 but the subsequent development has resulted in the commercial production of many new products, such as the safety fuel for airplanes and the hydrogenated solvents known as Solvesso. Most recent to attract the favorable attention of the aviation industry is the commercial, large-scale synthesis, by the hydrogenation process, of iso-octane (tri-methyl-iso-butyl-methane), which since its introduction for laboratory use by the Ethyl Gasoline Corp. almost ten years ago, has been universally accepted as the standard test fuel on which all anti-knock ratings (in terms of "octane numbers") are now expressed. Instead of an expensive, exclusive laboratory testing reagent, however, Hydroctane, as the new product is called, becomes available for commercial engine development and special aviation uses where a fuel with an octane rating of 100 or better is demanded. According to recent tests by the U. S. Air Corps such a fuel will give an increase of 15 to 30 per cent in power output over the 92 octane fuel, which has been the best previously available commercially.

Polymerized Gasoline

In the opinion of a number of commentators in the petroleum industry, the work that has recently been done on the catalytic polymerization of refinery gases to produce a new gasoline of excellent quality is likely to prove the most important chemical engineering achievement of the present decade. The companies that have participated most prominently in this development include the Phillips Petroleum Co., the Pure Oil Co., and the Universal Oil Products Co., The Texas Corp., and the Standard companies of Indiana and New Jersey. The outstanding contribution of the Universal Oil Products Co., reported before the New York meeting of the American Chemical Society and subsequently before the A.P.I. at Tulsa may be summarized very briefly as follows:

First, it makes possible the conversion of a practically worthless byproduct (of fuel value only) into a higher priced commodity for which there is a huge market.

Second, this process presents to the world a new gasoline which consists largely of unsaturated hydrocarbons and has an octane rating of 81 and a blending value of 115. No other gasoline on the market even approaches this.

Third, it adds greatly to the possible yield of gasoline from the crude oil available and at the same time adds to the useful power contained in that gasoline.

Fourth, its development from the original invention on which it was based, to the design, construction and successful operation, has been the work of chemical engineers and chemists under chemical engineering direction. It is a group effort of research, semi-works and commercial development, sales, management and administration.

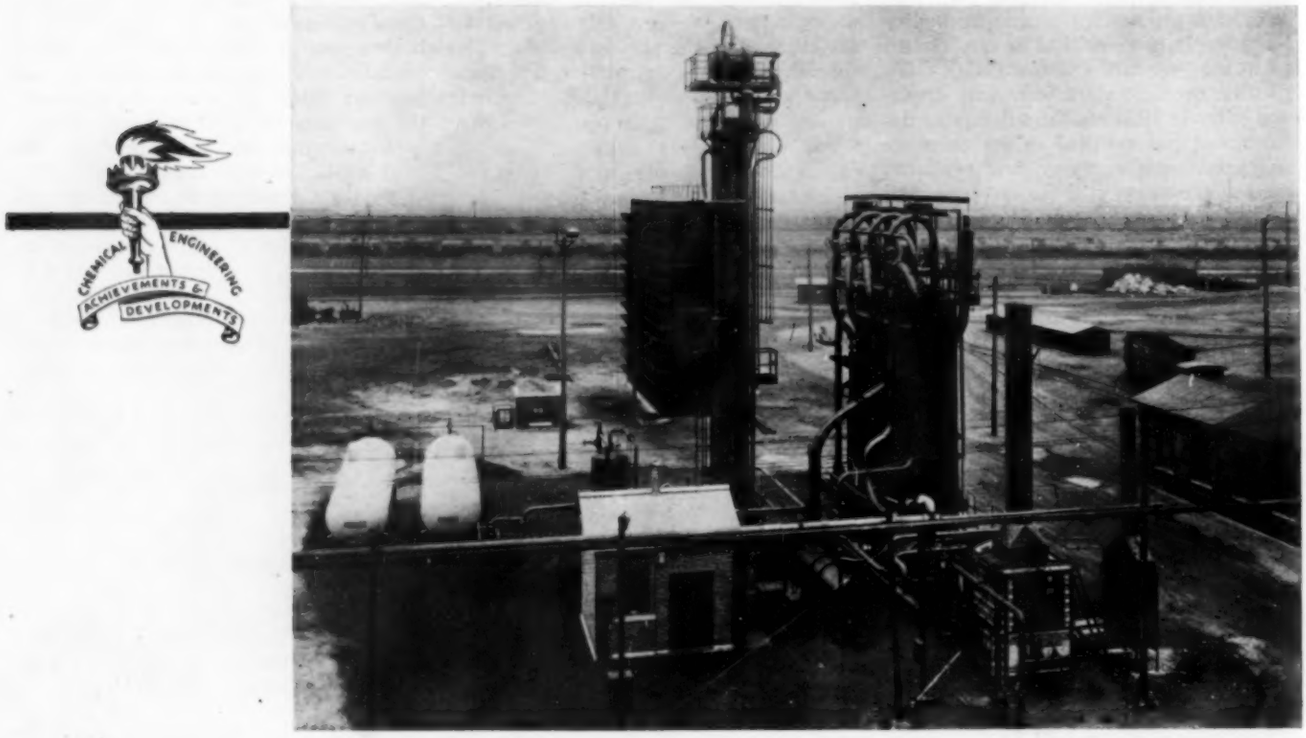
Other achievements of the Universal group include the (1) Equiflux furnace utilizing radiation more efficiently for heating oils—permitting rates of heat transfer that are said to double those achieved in the best designed heaters up to this time. (2) Anti-oxidants and gum inhibitors to prevent gasoline deterioration and to eliminate the necessity for acid refining. It has been estimated that these products are daily applied to more than 5,000,000 gal. of gasoline, resulting in annual savings of millions of dollars. (3) The Day process of refining cracked gasoline to yield higher quality motor fuel and (4) the multi-coil operation in cracking which enables the refiner to produce gasolines of higher anti-knock value than was possible with single coil operation.

Chemical engineering of a high order has likewise been shown by the progress in the design, construction and operation of huge refinery units that combine the processes of cracking, skimming, reforming and stabilizing. Costs of refining have thus been markedly reduced. The largest unit in the world is that recently put into operation at the new Texas City, Tex. refinery of the Pan American Petroleum Corp. This unit has a daily capacity of 35,000 bbl.

Acid From Waste Liquors

Industries in the heavy chemicals group do not move rapidly and ranking achievements are infrequent. But outstanding among recent developments in sulphuric acid is the Chemical Construction Corp.'s new process for manufacturing sulphuric acid from waste ferrous sulphate solutions, such as those occurring in steel pickling. Two in-

Panoramic view of the great dyeworks at Deepwater Point, N. J., in which the duPont company not only manufactures dyestuffs and related chemicals, but also makes tetraethyl lead, the synthetic rubber "DuPrene," synthetic camphor, industrial alcohol and many other products of chemical engineering enterprise. Less than two decades ago there was no industrial development in this area



Demonstration plant of the Universal Oil Products Co. where by catalytic polymerization unsaturated refinery gases are being converted into a new type of gasoline of high anti-knock and blending values at the rate of 5 gal. per M. cu.ft. of gas

stallations of the process have been made for a pigment manufacturer. The method, which has been described in *Chem. & Met.* (Mar., 1935, p. 139) consists in neutralizing any free acid with iron oxide subsequently produced, evaporating the liquor, reducing the sulphate to iron oxide and SO_3 and converting the SO_3 to strong sulphuric acid in a vanadium contact plant.

Paint and Varnish Progress

Like soap, sugar and several other of the older industries, paint and varnish technology had held to a fairly even keel until the revolutionary introduction of quick-drying pyroxylin lacquers in the early 1920's. But since then the industry has been subject to almost continuous change, with what has probably been a greater flood of new products and processes than in any other field. Particular activity has centered around the introduction of new synthetics—resins, solvents, plasticizers, emulsifiers, etc.—and of improvements in the quality, variety and cost of pigments.

The trend toward pigments of high-hiding power has greatly increased the importance of titanium dioxide, antimony oxide and zinc sulphide, which have been used to only a limited extent until the last few years. Among the newer pigments are zinc sulphide-magnesium silicate, and zinc sulphide-titanium dioxide. The past year has also witnessed improvements in treated lithopone for paints, making available a much broader variety, with specific properties, especially quick wetting, non-settling, good leveling and gloss.

The growth of the titanium pigment industry has been spectacular, as shown by the number and capacity of the new plants that have commenced production within the last few months. Among them is that of the National Lead Co.'s subsidiary, Titanium Pigment Co., at Sayreville, N. J., du Pont's subsidiary, Krebs Pigment & Color Co. at Edgemoor, Del., American Zirconium Corp., jointly owned by the Glidden Co. and Metal & Thermit Corp. at St. Helena, near Baltimore, Md. And one of the older plants, that of the Southern Mineral Products Corp., at Piney River, Va., has increased its output during recent months, largely as the result of chemical engineering research and development.

While the new resins, such as glyceryl phthalate and the oil-soluble phenol-formaldehyde compound have threatened nitrocellulose's quickly gained position of commercial supremacy, several research groups have been busy improving the quality and technique of applying the pyroxylin type of lacquers. A resulting achievement of the Hercules Powder Co. has recently (see *Chem. & Met.*, January, 1935, p. 36), attracted wide attention among chemical engineers.

The Hercules development consists of making pigmented and unpigmented nitrocellulose lacquers in the form of water emulsions—thus permitting the use of a minimum quantity of solvents, with a high viscosity lacquer base containing a larger amount of non-volatile products than has heretofore been possible. New lacquer emulsions are produced by first making a very heavy bodied, high-solid lacquer and then, instead of thinning it as is usually done, this heavy base is reduced to a workable consistency by emulsifying it, as the disperse phase, in water. A colloid mill or homogenizer is used for this purpose. In addition to the advantages of economy and simple application, lacquer emulsions will permit the application of a greater amount of solids for a given solvent cost and, very important, they reduce the fire hazard because of

Unique plant of Ethyl Dow Chemical Co. at Kure Beach, N. C., where Dow chemists and chemical engineers have successfully applied their remarkable process for recovering more than a half million pounds of bromine per month from seawater

their relative non-flammability. An open flame played over the surface of a lacquer emulsion will not cause ignition.

The Hercules group has also done considerable work on Tornesit, a chlorinated rubber largely used as a paint base where acid and alkali resistance are essential. Recent research has led to the development of a new low-viscosity type of Tornesit which makes it possible to spray such a paint—thus greatly widening the field of application.

Solvents, Diluents, and Resins

Among the products to find application as high-boiling solvents in the new lacquer emulsions with water are octyl acetate introduced by the Carbide & Carbon Chemicals Corp., butyl crotonate of the Niacet Chemicals, secondary hexyl alcohol of the Standard Alcohol Co. The latter group has also contributed a progressive development with its hydrogenated solvents produced at the Baton Rouge refinery of the Standard Oil Co. of La. Solvesso is said to open up a new field for lacquer formulation. The main drawback, heretofore, has been the low tolerance with solvents, which is common to most petroleum naphthas, but these new hydrogenated naphthas have a solvent power almost equal to that of toluol. This permits the replacement of a large percentage of that product, which not only effects a saving in cost but contributes other desirable features such as a milder odor and better non-lifting properties. These new naphthas are used extensively as the single solvent for many synthetic resin finishes. The demand for this purpose within recent months has made necessary an increased production capacity of several million gallons per year. (See *Chem. & Met.*, January, 1935, p. 50.)

Sulphonated naphthas have been introduced by the Associated Oil Co. under the trade name of Solosols. The Shell Chemical Co., entering more and more into the solvents market during the past two years has introduced isobutyric acid, as well as methyl ethyl ketone, methyl propyl ketone, secondary butyl and amyl alcohols. (See *Chem. & Met.* August, 1935, p. 434.) Other solvents that have attracted wide attention during the past two years include iso-amyl propionate made by the U. S. Industrial Alcohol Co. and iso-butyl propionate made by the duPont company.

Among plasticizers there have also been many new products introduced during the past few years. Notable among these are the ethyl and butyl benzoyl benzoates of the American Cyanamid Co., the glycolates such as methyl-phthalyl-ethyl glycolate, ethyl-phthalyl-ethyl glycolate, and butyl-phthalyl-butyl glycolate of the Monsanto Chemical Co.

In the resin field, in addition to the products and processes previously cited, there is Aquaplex, the water resin emulsion introduced by the Resinous Products and Chemical Co., the Goodyear Tire & Rubber Co.'s "Pliolite Resin," Koroseal of the B. F. Goodrich Co. (obtained by polymerization of vinyl chloride), the Thiokol Corp.'s polymethylene polysulphide (another synthetic rubber substitute widely used in applications where oil resistance is essential); Carbide & Carbon Chemical Co.'s "Vinyloid Resin," Resinous Products' "Amberal" and "Duraplex," Beck Koller's "Beckolin," and, lately Niacet's Sucrose Octa-Acetate—all these are finding more or less extensive use in this rapidly changing and developing field.

Editor's Note: Recent chemical engineering achievements in other process industries — including pulp and paper, soap, sugar, insecticides, cement, ceramics, and glass will be reviewed in **Chem. & Met.** next month.

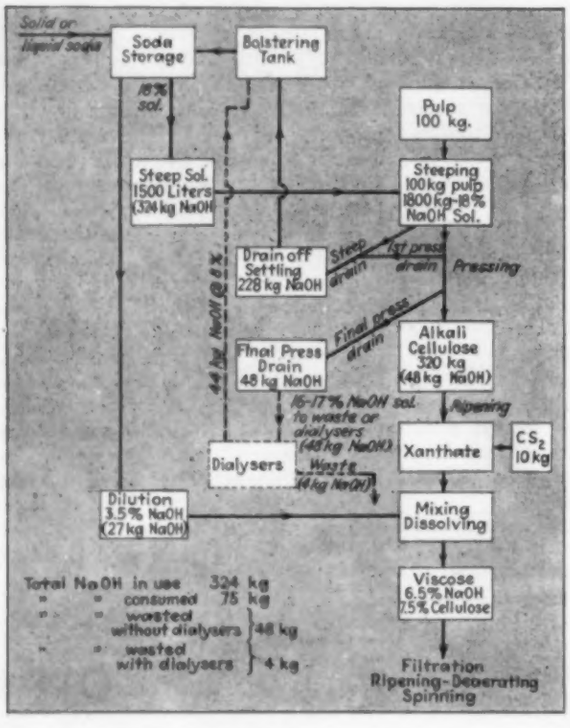
Caustic Soda Recovery

By JAMES A. LEE
Managing Editor of Chem. & Met.

FOR every pound of material produced in the viscose rayon industry, approximately 1¼ lb. of caustic soda is used. The greater quantity of the caustic, about 65 per cent, is employed in the steeping process, in which the cellulose sheets, generally both wood and cotton pulps, are steeped in an 18 per cent caustic solution, to convert them into alkali cellulose preliminary to the conversion to cellulose xanthate. The remaining caustic is consumed in the final step, in the production of the viscose spinning solution.

Until recently, where no other means of employing the solution used in the steeping process presented itself, it was either sold for a nominal amount or it was discarded. In other words, for every pound of caustic actually utilized in the conversion to alkali cellulose, one pound of caustic was thrown away. Thus for a number of years the industry was faced with a large economic loss.

Flow sheet of a viscose process showing recovery of caustic soda in the dialysers


Solid or liquid soda
Soda Storage
Bolstering Tank
18% sol.
Pulp 100 kg.
Steep Sol. 1500 Liters (324 kg NaOH)
Steeping 100 kg pulp 1800 kg-18% NaOH Sol.
Drain off Settling 228 kg NaOH
Steep drain
1st press drain
Pressing
44 kg NaOH @ 8%
Final press drain
Final Press Drain 48 kg NaOH
Alkali Cellulose 320 kg (48 kg NaOH)
15-17% NaOH sol. to waste or dialysers
Ripening
Dialysers
(48 kg NaOH)
Waste (4 kg NaOH)
Xanthate
CS_2 10 kg
Dilution 3.5% NaOH (27 kg NaOH)
Mixing Dissolving
Total NaOH in use 324 kg
" " consumed 75 kg
" " wasted without dialysers 48 kg
" " wasted with dialysers 4 kg
Viscose 6.5% NaOH 7.5% Cellulose
Filtration Ripening-Deaerating Spinning

More recently this loss has been almost entirely overcome in some of the plants, as for example, in the efficient and modern plant of the Tubize Chatillon Corp. at Rome, Ga., which the writer visited recently. It is accomplished by the use of Cerini dialysers, which recover 90 per cent of the caustic soda in the liquor obtained from the final pressing.

The direct operating cost of the dialyser is nominal: In the average plant in this country it amounts to about $550 per year, including all labor, materials and services, according to Louis E. Lovett, consulting engineer of New York, to whom the author is indebted for much of the information on the operation of the Cerini dialyser. Operating supervision consists only in sampling and a daily inspection of flow of solutions. No power or labor of any kind is required for the operation of the equipment itself.

The use of dialysers is not new, but their application to the recovery of caustic soda was a distinct forward step. The problem presented in the viscose rayon industry was the separation of a crystalloid, caustic soda from a solution in which impurities, mainly hemicellulose, are present in colloidal form.

The first development consisted of a dialyser made up of cast iron frames similar to a filter press and using a parchment paper membrane. This unit, while recovering from 80 to 85 per cent of the caustic soda content, was objectionable on account of the frequent changes of diaphragms which were necessary. Also, the failure of one diaphragm affected the purity of all the caustic solution recovered.

In 1926, Dr. Leonardo Cerini obtained patents on an automatic unit which from its inception proved a practical success. Today this dialyser is widely used in the recovery of caustic soda in the viscose process. In America over 25,000,000 lb. of caustic is recovered annually by its use. It is expected that by the end of 1935 this figure will reach 40,000,000 lb. It should be understood that the dialyser is not only important in the recovery of the waste caustic but also because it gives an almost absolutely pure material; for that reason some plants actually dialyze part of the first pressing liquor from the steeping presses.

The modern Cerini dialyser removes over 90 per cent of the dissolved hemi-cellulose and practically all the carbonates, metallic impurities, and shreds of pulp. Without dialysers, settling systems were used to remove soda impurities not in solution. The liquor, containing from

in the

Rayon Industry

Rayon plant of the Tubize Chatillon Corp. at Rome, Ga., surrounded by a community of attractive homes equipped with every modern convenience

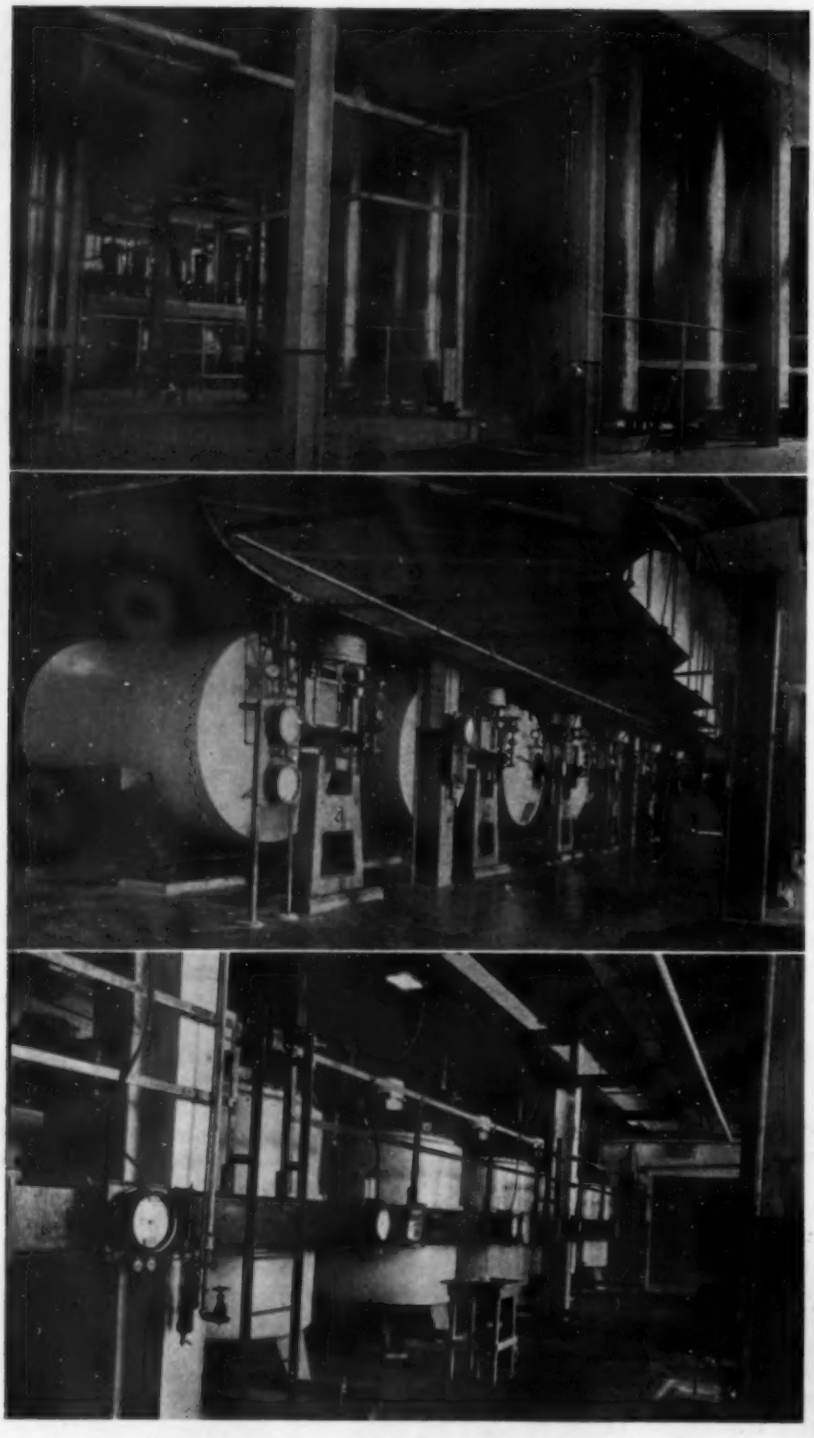
15 to 17 per cent caustic as received from the presses was blended with a strong caustic solution to form a fresh charge of steeping liquor. The recovered solution gradually became unfit for further use due to the increasing content of dissolved impurities, and in order to maintain a definite maximum impurity concentration, a portion of the liquor was continually withdrawn and sent to the sewer. This waste was actually in the neighborhood of 15 per cent of the total caustic circulated in the process and 64 per cent of the caustic usefully utilized.

The dialyser consists of a tank 10 ft. long, 5 ft. wide, and 4 ft. high, containing 50 diaphragms or membranes in the form of flat bags. This unit is capable of purifying a minimum of 1,500 liters of solution having a concentration of 16-17 per cent caustic soda per day, with a yield over 90 per cent of purified solution having a concentration of almost 8 per cent caustic; the volume of the recovered solution is approximately twice that of the original impure solution. Parallel diaphragms mounted independently of one another are made of specially treated cotton cloth produced by a carefully controlled process to insure long life and high purity of the product. Diaphragms have a life of not less than nine months and have in some cases been operating for almost two years without replacement due to failure of the fabric.

Each diaphragm assembly consists of a spirally woven mattress inside a flat cloth bag, and two rigid wire frames or grids placed on either side to form a sandwich construction. The object is to provide a large diffusion area for a small volume of liquid. An automatically regulated water supply is led through a distributing trough to connections at the top of each diaphragm. Two outlets at the bottom of the bag distribute the purified solution to collectors at each end of the tank. Impure solution is fed by gravity into the tank in the space around the diaphragms and waste impurities are permitted to flow off at a connection located at the liquid level in the tank. Water or purified caustic solution inside the bags is maintained at a level about one-half inch higher than the solution outside the diaphragms. Any diaphragm can be isolated from the system without interfering with the functioning of the other diaphragms. Failure of a diaphragm is indicated by a yellow tint in the glass tubes connecting with the collecting headers.

The Cerini dialyser functions on the principle of the osmotic exchange which takes place between solutions of different concentrations when separated by a semi-permeable membrane. Impure solution entering the dialyser tank near the bottom has an average concentration at that point of 24-25 Be. ($d = 1.2$), 16 per cent NaOH, 4 per cent carbonates, 2 per cent organic matter. As the water enters at the top of the diaphragm it becomes progressively charged with soda while the impure solution progressively loses its soda content; at the top of the tank its soda concentration is just sufficient to hold the hemi-cellulose in solution. The active diaphragm area in each unit is about 300 sq.m., each cell being 3 m. long, 1 m. high, and 2½ cm. wide. The average concentrations of the solutions are determined by controlling the relative flows.

The quantity of caustic soda diffusing through the diaphragm depends on the time, the area of dialyzing surface, and the mean concentration difference: i.e., $Q = KA\theta\ (\Delta c)\ av$, where K is the overall coefficient of diffusion for the diaphragm and temperature under consideration, according to D. J. Eynon (*Journ. of Soc. of Chem. Ind.*, June 1933). Since the concentration difference between the two solutions varies with the location of the section chosen, the mean difference is determined in terms of the concentration differences at each end. It is shown that the logarithmic mean concentration difference gives results which agree almost exactly with the results obtained from service tests. The velocity of solution flow is an important variable and one within the control of the operator. Thus a high velocity, decreasing the number of dialysers may be used, but this is done



Top—A large amount of floor space is required for storage and treatment of the caustic soda. Center—Xanthating department, each barrette has a capacity of 1,800 lb. of crumbs. Bottom—Cellulose xanthate is dumped through a chute into the Turbo mixers

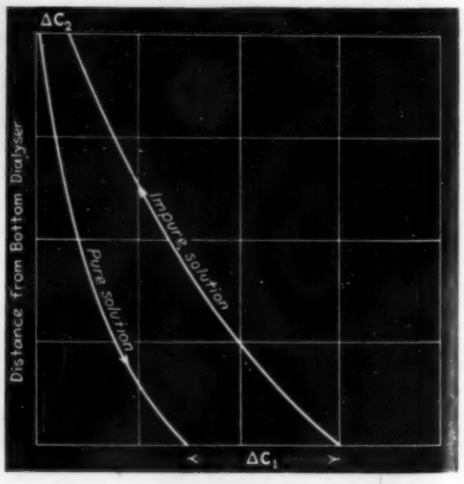
at the expense of a lower percentage recovery. The decision as to the velocity to be employed requires an economic balance between the cost of unrecovered soda and the cost of the dialysers.

The Georgia rayon plant of Tubize Chatillon is located in beautiful rolling country near the city of Rome from which it is screened by hills. The company has provided amply for the comfort and welfare of its employees. Surrounding the plant is a community of attractive homes equipped with every modern convenience. Schools, stores, and a spacious club house are included in the village.

The manufacturing plant has been laid out so that the acetate and viscose process buildings are parallel and separated by 100 yards or more in which the power house, machine shops, and offices are located. Each plant is arranged to take full advantage of straight-line production flow, the raw materials entering one end and the finished yarn leaving the other. However, this article is concerned merely with the production of rayon by the viscose process for it is in this process only that caustic soda is a factor.

Most of the raw materials are stored out-of-doors near the "chemical" building. As is customary, the carbon bisulphide is kept in tanks submerged under water, while the 95-98 per cent sulphuric acid and the ammonium sulphide are stored in tall steel tanks.

A large floor space in the buildings is required for storage and

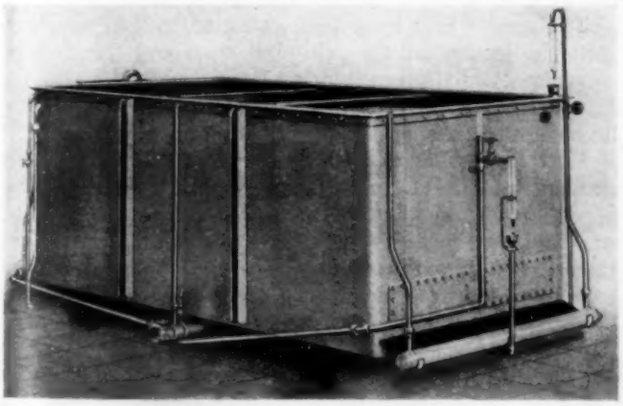


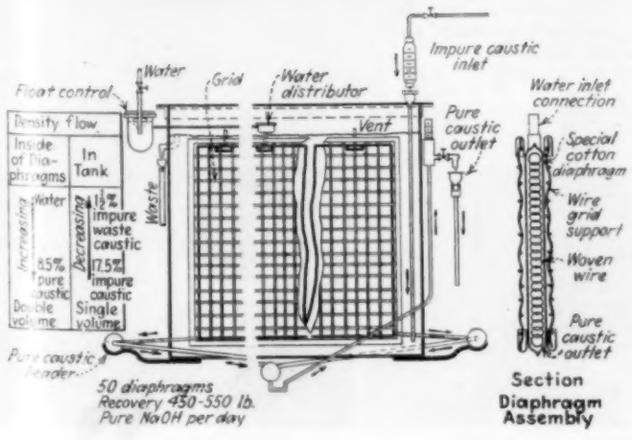
Logarithmic mean concentration difference. Counter-flow dialyser

treatment of the caustic soda, which is received at the plant as a 50 per cent solution. This is immediately diluted to 20 per cent in steel tanks covered with burlap over which cool water trickles. This solution is further diluted to 18 per cent by addition of the dilute caustic returned from the viscose processing. The solution is then pumped to brine cooling tanks to reduce further the temperature to 14 deg. C. for use as mixer soda or to 18 deg. for use in the steeping presses. A supply of latter type of caustic solution is temporarily stored in an insulated tank at the top of the processing building near the presses. An automatic device controls the level of the solution in the tank and assures a constant supply for the presses.

The first step in the viscose process is the steeping which may be described briefly as follows: 300 lb. of pulp sheets are placed on end in a horizontal bath press. This is filled with the dilute caustic solution, from the storage tank already referred to, at 18 deg. C., in which the hemi-cellulose content is fixed at from 0.25 to 0.5 per cent. The sheets are allowed to remain in the bath for about two hours, after which time the solution is drained out, the ram of the press is brought partly forward, and the liquor which is pressed out is added to the steep liquor previously withdrawn. The final pressing is then made and the liquor so obtained is separated from the steep and first pressing caustic solution because it is so contaminated with hemi-cellulose and foreign matter that it is unfit for re-use in the system until purified in the dialysers.

Cerini dialyser used by the viscose rayon industry for the recovery of caustic soda





The quantity of caustic soda used in the steeping process depends primarily on the quantity of sulphite wood pulp used in proportion to the cotton pulp. The function of the caustic soda is to dissolve the hemi-cellulose and certain foreign matter while mercerizing the cellulose to form alkali cellulose in as pure a state as possible. The hemi-cellulose remaining in the batch is carefully controlled as it has a pronounced effect on the final product.

Sulphite wood pulp as prepared for the rayon industry has an alpha cellulose content of about 89 per cent, whereas cotton pulp contains over 99 per cent alpha cellulose. Each manufacturer has developed his own particular standards in this regard so that it may be said that no two products are exactly alike.

All caustic soda solutions drawn off from the steeping presses prior to the final pressing are filtered first through sand filters and then through Sperry filters. All recovered caustic is used for mixer caustic at a concentration of about 3½ per cent. The weak caustic solution from the sump tank and final filter wash is recovered in the Cerini dialysers.

When the pressing is completed the charge is dumped from the end of the press into large pulp shredders. These are held at a constant temperature with brine. The revolving blades over the serrated saddle of the machines shred the sheets into fluffy crumbs. The grinding requires 2 to 3 hours, depending upon the nature of the pulp.

The shredded pulp is placed in aging cans, which are covered and sealed to keep out all carbon dioxide. The cans of alkali cellulose crumbs are moved into the aging room where the temperature of the mass is held at 22 deg. C. for a definite period.

The cans of ripened alkali cellulose are conveyed to the xanthating department where they are emptied into barrattes. Each machine has a capacity of 1,800 lb. of crumbs. Carbon bisulphide is added slowly over a period of approximately one-half hour; the entire xanthation process requires 2 to 3 hours. When the required amount of bisulphide has been added to the crumbs the pipe line to storage is flushed out with an inert gas as an additional safeguard against accidents.

The cellulose xanthate is dumped through a chute into the mixers containing a 3½ per cent solution of caustic soda located on the floor below. The crumbs are dissolved to form viscose. Turbo-mixers are held at a temperature of 15 to 17 deg. C. for the 4 to 5 hour period required for mixing and dissolving.

The viscose is blown by compressed air to ripening tanks located in a room held at a constant temperature of 18 to 20 deg. C. The solution is then filtered through Sperry presses and is finally blown to the spinning tanks where it is de-aerated by vacuum. The viscose solution is then ready for the spinning department where it is converted into yarn.

▼ ▼ ▼

Rayon Made Experimentally From Southern Pine

By D. YORK BRANNOCK
Chemistry and Chemical Engineering Department
Georgia School of Technology
Atlanta, Ga.

With

HAROLD BUNGER and ED DOUD
Respectively Project Director and Chemical Operator

IMPORTED spruce sulphite pulp, which is the common source of cellulose for rayon manufacture, is subject to various price factors which make a domestic source of rayon pulp desirable. Recent widespread interest in the work of the Georgia Pulp and Paper Laboratory, of Savannah, in producing good quality pulp and newsprint from southern pine, led the State Engineering Experiment Station of the University System of Georgia to attempt the development of a satisfactory commercial viscose rayon from this same sulphite pine pulp.

During 1932-33 a small-scale rayon unit was built and preliminary experiments were conducted in an effort to find satisfactory operating conditions for processing sulphite pine pulp. Most of these experiments were unsuccessful, failing to yield a viscose of satisfactory spinning properties. Toward the end of the period, however, the equipment had been sufficiently improved and the technique of operation sufficiently perfected to warrant an expanded program of research.

Beginning July 1, 1934, funds made available by the State Engineering Experiment Station made possible the employment of a full-time chemical operator and the assembly of a rayon pilot plant similar to those used in the industry for research in process control. The pilot plant was arranged to give results approaching as nearly as possible those of a commercial scale unit. It is true that data obtained in this manner are difficult to translate into terms of practice, but adequate precautions were exercised to produce good, qualitative information.

Innovations to be found in the unit operation equipment are in the design and construction of the shredder and the constant temperature storage facilities. The shredder used was designed in these laboratories and involves the use of opposed helical type rotating blades working against a central fixed cutting blade and the casing of the machine. Constant temperatures for the ageing and ripening processes were obtained in two different pieces of equipment. For temperatures above room, an electrically heated thermostatically controlled water bath was used. For temperatures below those of the room, a domestic type of electric refrigerator was the equipment employed.

As soon as it was demonstrated that rayon could be made from pine pulp by the viscose process, experiments were begun, looking toward the establishment of the limiting conditions of time, temperature, and concentration of reagents employed in the steps of the process. When these limits have been established, it will be possible experimentally to determine the optimum operating conditions for processing this new raw cellulose material.

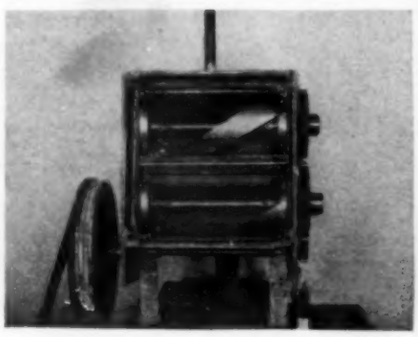
The data obtained while seeking the limits of operating control conditions, although not complete, offer criteria concerning the value of chemical newsprint pine pulp as a raw material for rayon manufacture. Further results include the successful use of pine pulp rayon as a filling with a cotton warp in the weaving of some 20 yards of fabric on a Jacquard loom. Prof. C. A. Jones (Director, A. French Textile School, Georgia School of Technology) conducted the weaving experiments and expressed the opinion that the pine rayon possessed very satisfactory textile properties. This rayon was from eight batches of experimental run and did not include any rayon having a tensile strength above 1.52 grams per denier. The average value was in the neighborhood of 1.25 grams per denier. It is expected that the textile suitability of this rayon will be greatly increased when operating optima are established.

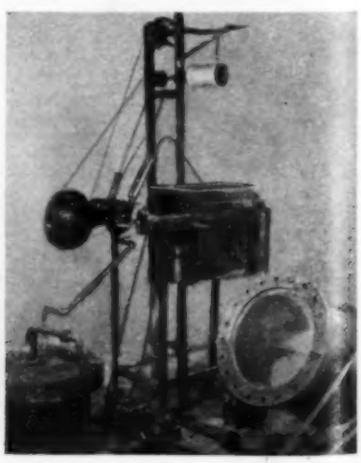
Certain departures from the standard viscose practice were found to be desirable. In order to produce a viscose which could be filtered and spun, a high ageing temperature for the soda cellulose was at first considered essential. Later work has led to the belief that the best temperature for this step in the processing is 25 deg. C., allowing about 70 hours for the ageing time.

The data which have been collected to date also give some indication of the optimum time and temperature conditions which prevail during the ripening period. The temperature is fairly well set at 20 deg. C., but the time limits can only be set between 50 and 100 hours.

Further conclusions of a general nature will not be drawn from these data, other than that it appears that a good grade rayon can be made from pine pulp. After working with this material for a long period, we believe that pine pulp will offer a satisfactory source of raw cellulose when it is available in sufficient quantities and at such a price as to warrant rayon manufacturers making the necessary changes in processing.

Rayon pilot plant equipment including, below, special alkali cellulose shredder and, at right, xanthating drum and spinning machine





The project described here was prosecuted under the auspices of the State Engineering Experiment Station of the University System of Georgia, and is published with the permission of W. H. Vaughan, Director.

Social Security Act

By G. CHAUNCEY PARSONS
New York, N. Y.

WITH the signing of the Social Security Bill by President Roosevelt, who remarked at the time that its enactment will give "at least some measure of protection to 30,000,000 of our citizens," the first step has been taken toward a new era in our social and economic life. Providing for long range old age pension and unemployment insurance systems, with additional provisions for the welfare of the aged, blind, indigent, the dependent mothers and children, the Social Security Act is by all odds the most far-reaching legislation ever attempted by our Congress.

The second part of the old age pension title sets up what will be known as the Federal Compulsory Contributory Pension Plan, consisting of a government sponsored annuity plan, similar to the private pension systems already in operation in many industries. Under this measure, workers will be eligible for retirement upon reaching the age of 65, provided that they fill certain requirements.

Payments from this fund will be financed by the levying of taxes of like amounts upon both employee and employer, and contributing workers will receive benefits regardless of their financial status or supplementary incomes. These tax levies will begin in 1937 at 1 per cent, increase in 1940 to 1½ per cent, in 1943 to 2 per cent, in 1946 to 2½ per cent, and in 1948, and thereafter to 3 per cent. The levy on employees will be known as an income tax and will be deducted from wages by employers and paid over to the government, together with the employers' share, designated as an excise tax, to the Department of Internal Revenue. These funds will be set aside in the treasury in a special fund to be known as the Old Age Reserve Account.

Pension Payments Under
A Good Insured Pension Plan
The Social Security Act

Average Monthly Salary	Years of Work								
	5	10	15	20	25	30	35	40	45
$25	$2.50	$5.00	$7.50	$10.00	$12.50	$15.00	$17.50	$20.00	$22.50
	.....	15.00	16.25	17.50	18.75	20.00.	21.25	22.50	23.75
50	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00
	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00
75	7.50	15.00	22.50	30.00	37.50	45.00	52.50	60.00	67.50
	16.25	20.00	23.75	27.50	31.25	35.00	38.75	42.50	46.25
100	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00
	17.50	22.50	27.50	32.50	37.50	42.50	47.50	51.25	53.75
125	12.50	25.00	37.50	50.00	62.50	75.00	87.50	100.00	112.50
	18.75	25.00	31.25	37.50	43.75	50.00	53.13	56.25	59.39
150	15.00	30.00	45.00	60.00	75.00	90.00	105.00	120.00	135.00
	20.00	27.50	35.00	42.50	50.00	53.75	57.50	61.25	65.00
175	17.50	35.00	52.50	70.00	87.50	105.00	122.50	140.00	157.50
	21.25	30.00	38.75	47.50	53.13	57.50	61.88	66.25	70.63
200	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00
	22.50	32.50	42.50	51.25	56.25	61.25	66.25	71.25	76.23
225	22.50	45.00	67.50	90.00	112.50	135.00	157.50	180.00	202.50
	23.75	35.00	46.25	53.75	59.38	65.00	70.63	76.25	81.88
250	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00
	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00
300	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00
	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00
400	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00
	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00
500	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00
	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00.
750	75.00	150.00	225.00	300.00	375.00	450.00	525.00	600.00	675.00
	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00
1,000	100.00	200.00	300.00	400.00	500.00	600.00	700.00	800.00	900.60
	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00

In order to be eligible for a pension under the Social Security Act, a retired worker must have reached the age of 65 not prior to Jan. 1, 1942, and must have paid taxes on at least one day's employment in each of five calendar years after Jan. 1, 1937, and up to the day he reaches the age of retirement. Thus, no worker born prior to Jan. 2, 1876, is eligible to receive a pension, although he will receive, if he retires at 65, a lump sum payment of 3½ per cent of the total wages upon which he has paid taxes. This will, during the first years of the plan, amount to considerably more than both he and his employer have paid in taxes.

The eligible worker must have paid, during his working years, taxes on at least $2,000 total wages. His pension will be based upon this aggregate amount: if his wages have totaled less than $3,000 he will receive one-half of one per cent of the amount each month; if wages have exceeded $3,000, he will receive (1) one-half of one per cent of $3,000, plus (2) one-twelfth of one per cent of wages exceeding $3,000 and not exceeding $45,000, plus (3) one-twenty-fourth of one per cent of all wages exceeding $45,000. To receive the maximum pension, therefore, an employee will have to pay taxes on $129,000 or more; if he receives the maximum salary taxable under the plan, $3,000 per year, he will be required to work for 43 yr. in order to retire at age of 65 with an $85 per month pension.

Excluded from benefits and taxation under the workers' pension plan are domestics working in private employment, farm laborers, casual and itinerant laborers whose services are not in line with the employers' regular business, persons who have already reached the retirement age, municipal, county, state and Federal employees, officers and men on ships of American registry, and those persons employed by non-profit making organizations, such as charitable institutions.

The Social Security Act as presently formed denies employers the alternative of private pension systems, whether already in operation or not. Thus, it is quite likely that many employers will be disposed to scrap private plans, feeling that they cannot afford the additional expense involved. A study of the accompanying chart, which compares benefits of the Federal plan with those of several existing private pension systems, will show the error of such reasoning, particularly as regards higher paid employees and white collar workers.

The effect of this measure upon a beneficiary earning $3,000 a year has already been pointed out. Since the maximum pension will be $85, it is obvious that the pension will be of little benefit to the beneficiary who prior to retirement has drawn a salary of more than $3,000. If protected by such a private pension arrangement as is used in the table for comparison, he will receive a monthly income amounting to two-thirds of his erstwhile salary, an amount sufficient to insure leisure and comfort in his old age. The Federal plan will give him little more than a pittance by comparison.

Making Concentrated Superphosphate at T. V. A. Fertilizer Works

By HARRY A. CURTIS
Chief Chemical Engineer
Tennessee Valley Authority
Knoxville, Tenn.

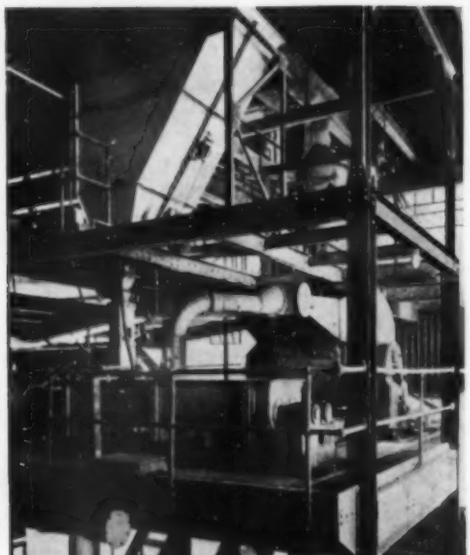


Fig. 1—Superphosphate mixing and conveying equipment

In an earlier paper (A.I.Ch.E. May meeting and *Chem. & Met.*, June, 1935) there was a description of the manufacture of phosphoric acid by the electric furnace method in a plant constructed by the Tennessee Valley Authority at Wilson Dam, Ala. The present paper describes the methods and equipment used in the T.V.A. Fertilizer Works for the manufacture of a concentrated superphosphate from phosphoric acid and ground raw phosphate or ground limestone. A brief discussion is also given of some of the small-scale experimental work which laid the foundation for the commercial plant construction.

PHOSPHATE ROCK is received at the Works, crushed, dried and screened as described in the previous paper. The fines from the screens are used in the manufacture of superphosphate as described below. These fines carry some of the clay originally adhering to the lumps of phosphate rock and, therefore, are of somewhat lower grade than the lump rock. It is necessary to use the fines in this manner, but, because of their contamination with clay, the superphosphate produced analyzes 43 to 45 per cent P_2O_5, whereas a higher grade of ground raw phosphate would yield a product carrying 46 to 48 per cent P_2O_5.

The dry fines are ground in air-swept roller mills and the dust blown to silos adjacent to the fertilizer manufacturing building. Phosphoric acid from the acid sumps previously described is pumped to small storage tanks inside the manufacturing building and the strength of the acid adjusted to 78 per cent H_3PO_4. Dust and acid are weighed out in the proper proportions and dumped into the bowl of a powerful mixer. After mixing, the superphosphate, now in the form of a stiff, rapidly hardening mud, is dumped on to a pan conveyor and carried to an elevator. The elevator discharges the superphosphate into small bins which in turn deliver it to a monorail dump car running along the apex of the storage building. The storage building is a double-A frame building 201 ft. wide by 250 ft. long, providing storage for about 20,000 tons. From the storage piles the superphosphate is moved into the shipping building, where it is disintegrated, screened and bagged as in other modern plants.

In Fig. 1 the mixing equipment used is shown, while Fig. 2 presents a flow diagram of the plant. Figs. 3 to 8 are views taken at various points in the plant and easily identified from their captions.

Batch Mixing

It will be recalled that in the wet method of preparing phosphoric acid, by the treatment of ground raw phosphate rock with diluted sulphuric acid, there is obtained a solution of phosphoric acid of strength 20 to 45 per cent. Acid of this strength is unsuitable for the manufacture of concentrated superphosphate and must be concentrated. In the older fertilizer works the concentration is accomplished by boiling the acid in wooden tanks fitted with steam coils of lead pipe. The newer plants use more efficient evaporators, but in either case it is not practical to concentrate the acid beyond 50 to 55 per cent H_3PO_4. When acid of this strength is mixed with the stoichiometric amount of ground raw phosphate, there is obtained a sticky mass which must subsequently be dried by very long storage or by artificial means.

In the electric furnace method of preparing phosphoric acid, however, any strength of acid desired may be obtained. The first problem undertaken by T.V.A. in the fertilizer program was the development of methods for using the concentrated acid with ground raw phosphate or ground limestone to produce a concentrated superphosphate in a relatively dry condition, eliminating the costly drying procedure ordinarily used. The current opinion at the time, based on published small-scale tests, was that, owing to the very rapid setting of the mixture, good results could not be obtained with acid of concentration above about 65 per cent H_3PO_4.

The first step in the program was the purchase of a small but powerful kneading machine. In this little machine it was easily demonstrated that phosphoric acid of any strength up to 95 per cent may be mixed with ground raw phosphate or with limestone, and the mixer kept running while the charge passes through all stages from a slurry to a stiff mud, to a granular product which may be piled up on the floor without caking. It was shown that a satisfactory degree of reaction between the raw phosphate and the acid may be obtained with any concentration of acid. The small-scale tests indicated that in plant operation an acid in excess of 72 per cent H_3PO_4 would probably be necessary and that an acid of strength 76 to 80 per cent H_3PO_4 would probably be the best suited.

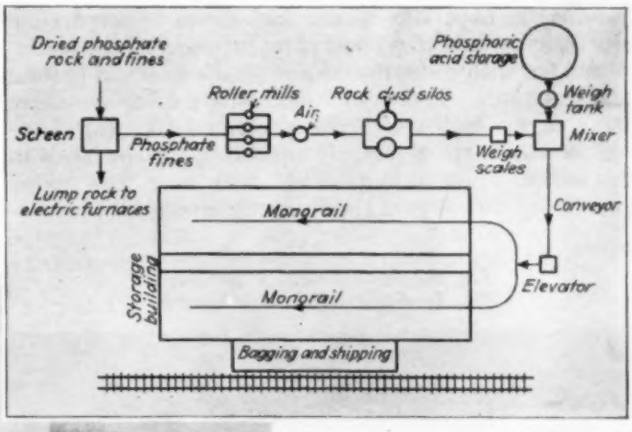
In the small kneading machine the time required for the mixture to pass from its initial soupy condition to a relatively dry lumpy material which could be sent to the storage pile was about 10 minutes with 78 per cent acid. It was, therefore, concluded that a commercial machine with a bowl capacity of 1 ton of ground rock, with the requisite quantity of acid, would have a capacity of about 6 tons per hour.

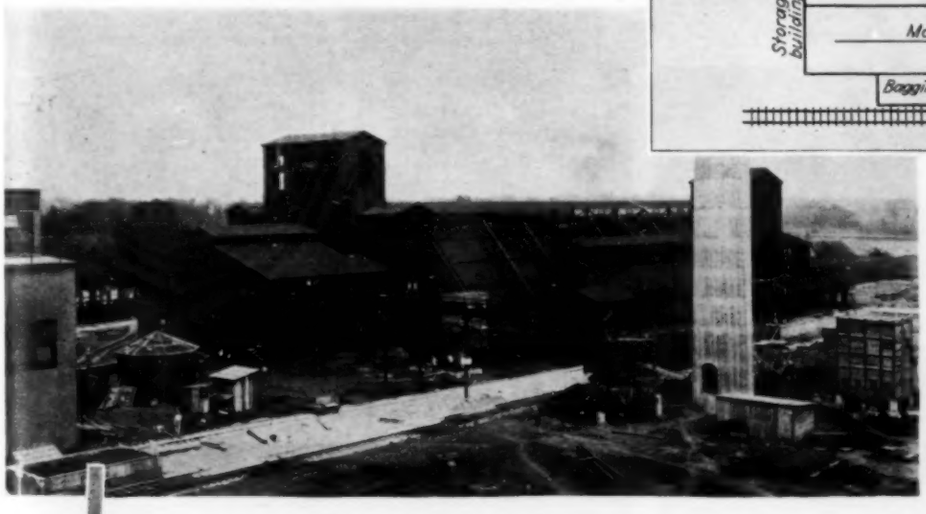
By the time the experimental work had reached this stage it appeared possible that a continuous mixer could be developed, but it was necessary without further delay to select a mixer for the commercial fertilizer works then under construction. A powerful commercial kneading machine was purchased and installed in the plant. This big machine has a bowl capacity sufficient for 1 ton of ground rock, but it was soon found in practice that only 1,200 lb. of rock per batch could be mixed. This was a disappointment, but it was more than offset by the discovery that it is not necessary to mix the rock and acid for 10 minutes. The mixing time was reduced to 1½ minutes. The superphosphate leaves the machine while still in a somewhat plastic condition. The tumbling which the material receives as it passes from the mixer to the pan conveyor, to the elevator and other handling equipment, reduces it to lumps not over 1 in. diameter.

This batch mixer is shown in Fig. 9. It has an actual capacity of more than 12 tons per hour on steady operation. The machine is driven by a 30-hp. motor, has a 3-hp. motor on the tilting mechanism and a 1-hp. motor on the oil pump. Each batch of rock and of acid is weighed accurately. Acid of 78 per cent strength is used, the quantity of acid per batch being 4 per cent less than the theoretical required for the rock. Superphosphate to the amount of 16,000 tons has been produced in a single mixer to date (June, 1935).

A typical analysis of the superphosphate produced is as follows after eight weeks storage:

	Per Cent
Moisture	8.8
Free acid P_2O_5	2.6
Water soluble P_2O_5	37.6
Citrate insoluble P_2O_5	1.9
Available P_2O_5	44.3
Total P_2O_5	46.2





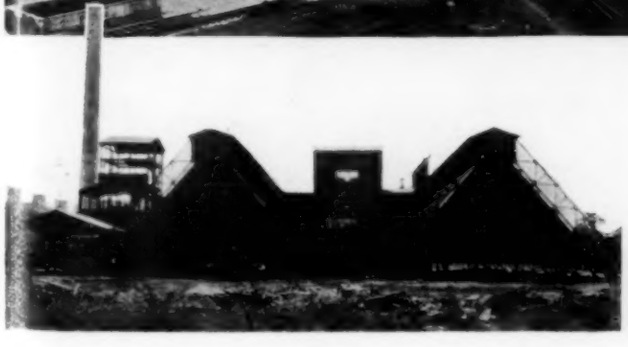


Fig. 2—Flow diagram of T.V.A. superphosphate manufacturing plant

Fig. 3—Superphosphate manufacturing and storage building nearing completion

Fig. 4—Superphosphate manufacturing and storage building under construction

Continuous Mixing

When concentrated phosphoric acid (say, 78 per cent) is mixed with ground raw phosphate, the mixture remains fluid for a short time. The fineness of the rock, temperature and strength of the acid and, to some degree, the rate of stirring, all influence the length of time the mixture remains fluid. Under practical conditions of mixing rock dust and acid the period is less than 1 minute.

This, however, is ample time to accomplish a thorough mixing of dust and acid if only the agitation of the mixture be rapid. It was learned from many small-scale experiments that once this initial thorough mixing had been attained, the only useful purpose served by further mixing or kneading of the rapidly thickening mixture was to prevent the formation of hard masses too large to be handled conveniently by the handling equipment carrying the superphosphate to storage. This suggested that a continuous process might be developed in which the dust and acid, properly proportioned, would be fed first into a small, high-speed mixing device, this mixer discharging into a slow-speed paddle conveyor which would serve to break up the mass into small lumps as the material "set up" through chemical reaction.

An experimental machine of this type was constructed in the winter of 1933-34. It was used at first with concentrated phosphoric acid and ground limestone to prepare monocalcium and dicalcium phosphate. The machine worked smoothly and served to prepare 20 tons of these products for some field tests in which the agricultural division of T.V.A. was interested at the time.

This experimental unit is shown in Fig. 10. It will be noted from the label on the acid carboy that the T.V.A. phosphoric acid plant at Wilson Dam had not begun operation at the date of the experiment.

After the experimental unit had served to prepare the monocalcium and dicalcium phosphate mentioned above, it was fed with concentrated phosphoric acid and ground raw phosphate. It operated successfully on this mixture also, but the high speed mixer required frequent cleaning, because hard layers of superphosphate built up in the mixer. The rock dust and acid were then added directly to the larger, slower-speed mixer, and it was found that a sufficient mixing was obtained by this means. In fact, in this, and all subsequent work, a surprisingly small degree of mixing has been found sufficient to give a satisfactory contact of acid and dust, judging by the completeness of the chemical reaction in the finished product.

At the conclusion of the experimental program outlined above, a full scale commercial continuous mixer was installed in the fertilizer works. Considerable difficulty was encountered at first with this machine. In the experimental unit, the acid had been proportioned by means of a constant-head tank and an orifice, which worked well, but which required manual adjustment whenever the analysis of the phosphate dust necessitated a change in dust-acid ratio. In order to facilitate this adjustment in the commercial unit, a variable-stroke plunger pump was adopted, the pump motor being interlocked with the dust feeder. The pump did not function well, because the crude phosphoric acid carried some dirt which interfered with the pump valves. A simple dipper type of acid feed was finally substituted and has given a satisfactory performance. A constant-head tank with an orifice feeder has also proven satisfactory.

In the experimental unit a volume-time feeder (Savage-Gauntt) was used for the ground phosphate. A star-wheel feeder, which is also a volume-time device, was installed on the commercial unit but gave difficulty at first, owing to lack of uniformity in the bulk-density of the ground phosphate. This difficulty was overcome fairly well by keeping the rock dust in the feed hopper above the star-wheel at about the same level, and attaching an electric vibrator to the hopper. The continuous mixer has a capacity of about 3 tons of superphosphate per hour. Fig. 11 is a view of the full-size continuous

Fig. 5—Superphosphate in storage
Fig. 6—Screens for superphosphate

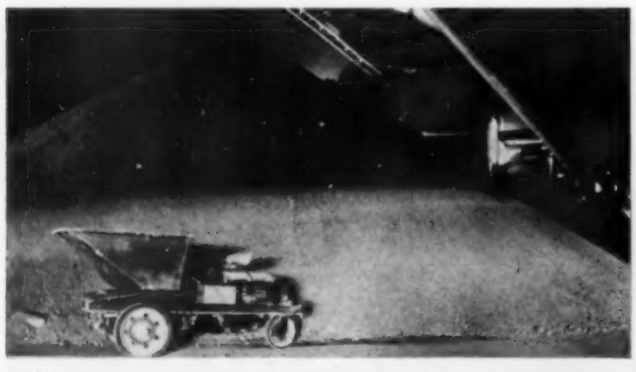
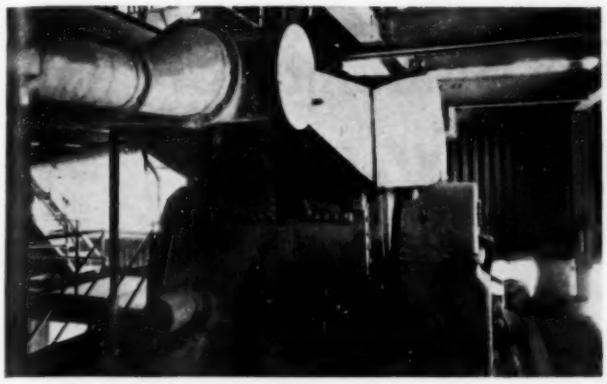
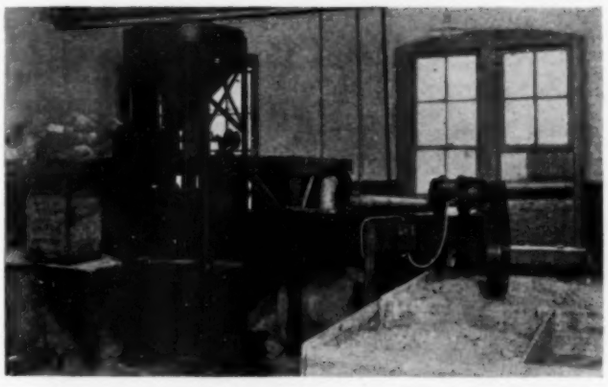


Fig. 7—Superphosphate bagging room
Fig. 8—Shipping floor for superphosphate





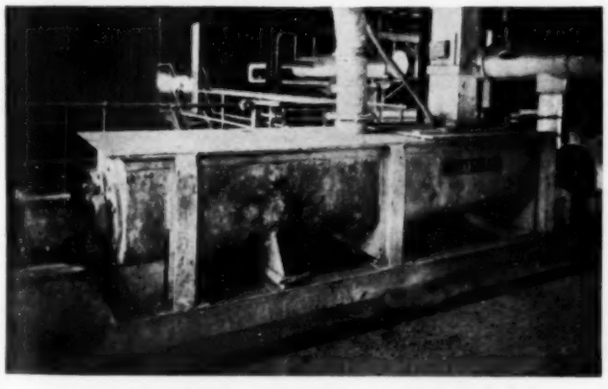


Fig. 9—Batch mixer for raw phosphate and acid
Fig. 10—Experimental continuous mixer for calcium phosphate
Fig. 11—Superphosphate continuous mixer

mixer. The body of the mixer is 32 in. wide, inside, by 10 ft. long. It carries two shafts revolving at different speeds, one with two rows and one with three rows of paddles. The mixer is driven by a 30-hp. motor.

Ideal Mixing Process

It will be recalled from the recital above that the high-speed mixer, followed by a slow-speed paddle conveyor, operated successfully in making superphosphate from limestone and concentrated phosphoric acid, but that a single slow-speed mixer was adopted for use with phosphate rock dust and concentrated phosphoric acid. As noted above, this machine is in successful operation. It does not represent an ideal solution of the problem, however, and the power consumption per ton of output is unnecessarily high, as the following considerations show.

When the rock dust and acid are first mixed, the mixture remains very fluid for a short period of time, say 20 seconds. This length of time is, however, quite long enough to permit a thorough mixing if a high-speed mixer be used. The power required for this mixing is obviously very small per unit throughout. Once the rock dust and acid have been thoroughly mixed, there is no occasion to continue the mixing or kneading during the time the mixture is passing through the thickening stage, or the stiff-mud stage, during which time much power would be required on the mixer. When the mass finally reaches the crumbly stage, it may be very easily broken up in small lumps, this step requiring little power per unit of product. After disintegration, a short interval, say 5 minutes, must elapse before the superphosphate has hardened sufficiently to permit piling in storage. This behavior of a rock dust-acid mixture indicates clearly the logical equipment for a continuous process:

1. A continuous high-speed mixer.
2. A slow-speed conveyor carrying the mixture away from the high-speed mixer, on which the mixture remains until it reaches the crumbly stage.
3. A simple disintegrator. This may be an inclined plate down which the material is allowed to roll; or it may be a rotating drum, or any other simple device.
4. A slow-moving conveyor on which the superphosphate remains until it "sets" and hardens sufficiently to permit piling in storage, without subsequent setting up of the pile as a whole.

Development of a process along these lines is now nearing completion in the T.V.A. chemical engineering laboratory. The chief difficulty has been in devising a continuous high-speed mixer which would not require frequent cleaning. A commercial-scale unit will be built as soon as the small-scale development is completed.

Spray Method

The rapid rate of reaction between concentrated phosphoric acid and ground raw phosphate gave rise to the idea that it might be possible to mix the acid and dust, properly proportioned, in a spray nozzle set at the top of a tall tower. The fluid mixture leaving the nozzle would assume the form of droplets, and by proper control of spray conditions, these droplets might be made directly in sizes suitable for fertilizer, thus avoiding subsequent grinding of the superphosphate.

It is necessary that the fluid droplets formed by the spray should "set up" sufficiently in falling through the tower to be relatively dry and non-cohesive by the time they reach the foot of the tower. The fineness of the rock dust, the temperature of the acid, and the strength of the acid all effect the rate of "setting" of the mixture, and all of these may easily be controlled. And, in order to facilitate the completion of the reaction, the droplets may be allowed to fall through an upward-moving current of warm air.

A process involving the spraying of a rock dust-acid mixture to form fertilizer screen size superphosphate is likewise in final stages of small-scale development in the T.V.A. laboratory. In spite of the fact that spray drying is a common procedure in several industries, its application to superphosphate manufacture has been a difficult development.

New Nomographs for Solubility of Sulphur Dioxide in Water

By D. S. DAVIS
Dale S. Davis' Associates
Watertown, Mass.

CONSIDERABLE work on the solubility of sulphur dioxide in water has been done since the appearance of Sherwood's compilation (*Ind. Eng. Chem.*, **17**, 1925, p. 745) and critical study of the results of the earlier investigators. The newer data, for the most part, deal with *total* pressures of sulphur dioxide and water instead of *partial* pressures of SO_2. Higher values of the solubility also are covered and temperatures up to 120 deg. C. are now included.

Such data covering ranges of industrial importance are those of Maas and Maas (*J. Am. Chem. Soc.*, **50**, 1928, p. 1352) and of Campbell and Maas (*Pulp & Paper Mag.*, Can., **29**, 1930, p. 599). These investigators have presented their results in tabular form and in the form of pressure-concentration isotherms, spaced, in most cases, at wide temperature intervals. In addition, the isotherms are slightly curved, interpolation between them is somewhat uncertain, and it is difficult to take full advantage of these excellent data.

As in the case of the earlier solubility material for which charts and equations have been prepared (Davis, *Chem. & Met.*, **39**, 1932, p. 615) there appears to be need for equations relating pressure, temperature, and solubility and for a more convenient graphical representation. It is the purpose of the present paper to offer such correlations together with alignment charts which permit rapid and accurate solution of the equations.

The data of Maas and Maas cover the temperature range, 10 deg. to 27 deg. C., while the Campbell and Maas data may be divided, for convenience, into two parts: that between 25 deg. and 90 deg. C. and that between 90 deg. and 120 deg. C. The three ranges are represented by three equations, noted on Figs. 1-3, which are all of the form,

$$S = m\,P + a\,\sqrt{P}$$

where S = solubility, grams SO_2 per 1,000 grams water
P = total pressure, SO_2 and H_2O, mm. mercury
and m and a are empirical functions of the temperature.

Although the expressions for m and a are of purely empirical origin the general form of the solubility equations is analogous to that derived by Lewis, quoted by Haslam, Hershey, and Kean (*Ind. Eng. Chem.*, **16**, 1924, p. 1224) from sound theoretical considerations:

$$c = H\,p + \sqrt{K\,H\,p}$$

where c = solubility, grams SO_2 per ml. of solution
p = partial pressure of SO_2, mm. mercury
and H and K are the Henry's Law and dissociation constants, respectively.

Accuracy of Solubility Calculations

Equation	t, Temp., deg. C.	P, Total Pressure, mm. Hg	S, Solubility, Grams SO_2 per 1,000 Grams H_2O	Average Deviation in Solubility, Per Cent ±
1	10	243–1,543	48–300	1.5
	16.5	310–1,884	47–294	0.9
	22	378–1,861	46–287	1.5
	27	448–2,556	45–280	1.1
2	30	232– 845	23– 80	1.5
	40	194–1,165	12– 79	2.6
	50	281–1,536	11– 78	2.2
	60	396–1,977	11– 77	2.1
	70	540–2,494	11– 76	2.1
	80	732–3,083	11– 74	2.6
	90	971–3,290	11– 64	2.3
3	90	971–3,290	10– 64	2.4
	100	1,275–2,801	10– 39	1.5
	110	1,663–3,380	10– 38	2.4
	120	2,130–3,440	10– 29	3.1

An accompanying table illustrates the agreement, at various temperatures, between calculated and actual values of the solubility over the ranges of data specified.

A nomographic chart has been prepared to solve each of three equations. Each of these charts, Figs. 1-3, in addition to the pressure and temperature axes, carries two solubility scales, labeled S and σ, the former for solubilities in grams SO_2 per 1,000 grams of water and the latter for solubilities in grams SO_2 per 1,000 grams of solution. The relation between the two is given by the equation,

$$S = \frac{1{,}000\,\sigma}{1{,}000 - \sigma} \text{ or } \sigma = \frac{1{,}000\,S}{1{,}000 + S}$$

Use of the alignment charts is illustrated as follows:

Fig. 1—What is the solubility of SO_2 at a total pressure of 1,700 mm. mercury and at 17 deg. C.? Connect 1,700 on the right P-scale with 17 on the upper t-scale and project the line to the left P-scale, calling the latter intersection A. Connect 1,700 on the left P-scale with 17 on the lower t-scale and call the intersection with the right P-scale B. A line between A and B will cut the S-scale at 258 grams SO_2 per 1,000 grams of water and the σ-scale at 205 grams SO_2 per 1,000 grams of solution.

The unique feature of Fig. 1 is the longer temperature axis along which temperatures increase until 22.86 deg. C. is reached, after which the scale, in increasing further, starts back along the axis.

Fig. 2—Given the total pressure as 1,500 mm. mercury and the temperature as 80 deg. C., how much SO_2 will dissolve in 1 kg. of water? How much will be contained in 1 kg. of solution? Draw a line from 1,500 on the right P-scale through 80 on the upper t-scale to the left

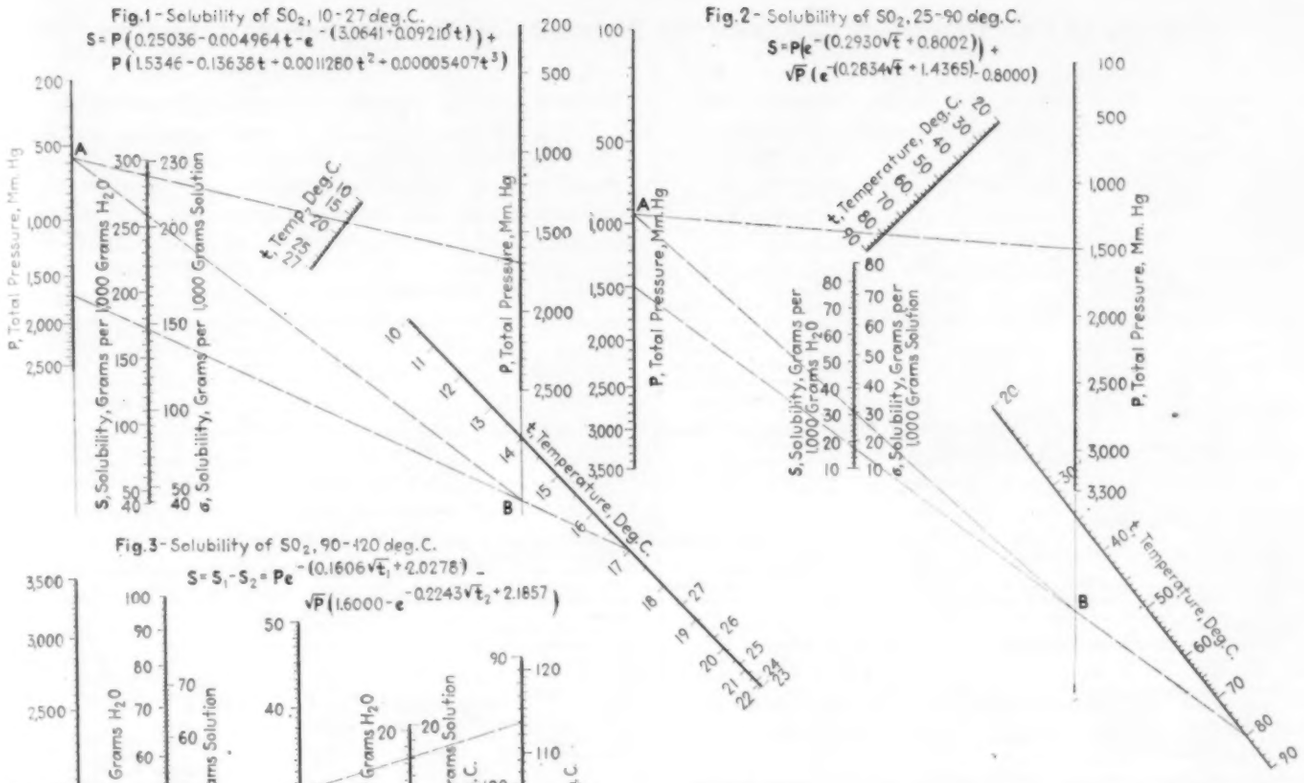


Fig.1 - Solubility of SO_2, 10-27 deg.C.
$S = P(0.25036 - 0.004964t - e^{-(3.0641 + 0.09210t)}) + P(1.5346 - 0.13638t + 0.0011280t^2 + 0.00005407t^3)$
P, Total Pressure, Mm. Hg
S, Solubility, Grams per 1,000 Grams H_2O
σ, Solubility, Grams per 1,000 Grams Solution
t, Temp. Deg. C.
t, Temperature, Deg. C.
A
B

Fig.2 - Solubility of SO_2, 25-90 deg.C.
$S = P(e^{-(0.2930\sqrt{t} + 0.8002)}) + \sqrt{P}(e^{-(0.2834\sqrt{t} + 1.4365) - 0.8000})$
P, Total Pressure, Mm. Hg
S, Solubility, Grams per 1,000 Grams H_2O
σ, Solubility, Grams per 1,000 Grams Solution
t, Temperature, Deg. C.
A
B

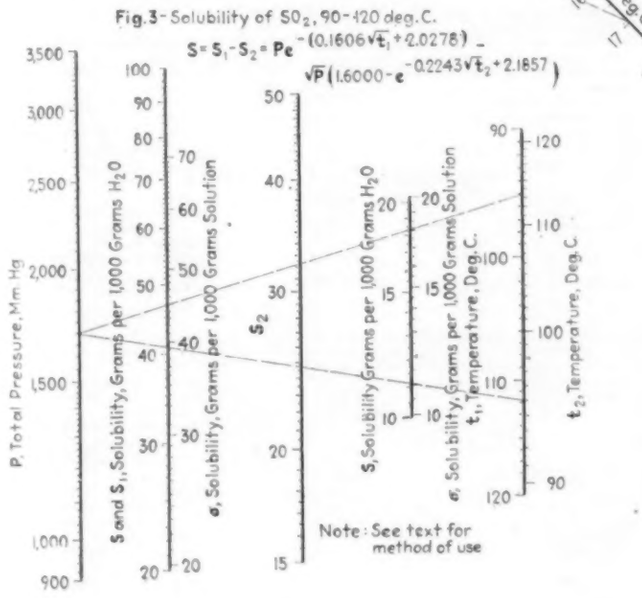


Fig.3 - Solubility of SO_2, 90-420 deg.C.
$S = S_1 - S_2 = Pe^{-(0.1606\sqrt{t_1} + 2.0278)} - \sqrt{P}(1.6000 - e^{-0.2243\sqrt{t_2} + 2.1857})$
P, Total Pressure, Mm. Hg
S and S_1, Solubility, Grams per 1,000 Grams H_2O
σ, Solubility, Grams per 1,000 Grams Solution
S_2
S, Solubility Grams per 1,000 Grams H_2O
σ, Solubility, Grams per 1,000 Grams Solution
t_1, Temperature, Deg.C.
t_2, Temperature, Deg.C.
Note: See text for method of use

P-scale and consider this intersection as point A. Draw a line from 1,500 on the left P-scale to 80 on the lower t-scale and consider the intersection of this line with the right P-scale to be point B. A line connecting A and B will cut the S-scale in the value of 31.0 grams SO_2 per kilo of water and the σ-scale in the value of 30.0 grams SO_2 per kilo of solution.

Fig. 3—In contrast to Figs. 1 and 2, in which both multiplication and addition operations are performed graphically, Fig. 3 is logarithmic in nature and performs only the operations indicated by $m\,P$ and $a\sqrt{P}$ requiring supplementary addition to complete the calculation. The original equation,

$$S = m\,P + a\sqrt{P}$$

is split into the equations,

$$S_1 = m\,P \text{ and } S_2 = a\sqrt{P}$$

so that $S = S_1 + S_2$. To avoid negative values of S_2 the signs of the terms in the expression for a are changed so that $S = S_1 - S_2$.

On both bases what is the solubility of SO_2 at a total pressure of 1,700 mm. mercury and a temperature of 95 deg. C.? From 1,700 on the P-scale draw a line to 95 on the t_1-scale and another to 95 on the t_2-scale. The first line cuts the S_1-scale at 47.0, while the second cuts the S_2-scale at 24.8. The difference, 22.2, is the value of S in grams SO_2 per 1,000 grams of water and is seen to correspond to 21.7 grams SO_2 per 1,000 grams of solution on the σ-scale. To avoid an unduly large chart, conversion between the S and σ-scales for values between 10 and 20 is made on the short axis in the right half of the chart.

Design and Equipment of a Chemical Engineering Laboratory

By NORMAN W. KRASE

University of Illinois
Urbana, Ill.

LABORATORY instruction in chemical engineering in the United States follows two distinct methods: first, by cooperation with industry and establishment of practice stations, students are sent into plants where equipment actually in operation is used for tests and measurements; and second, experimental facilities are provided at the educational institution. The relative merits of these methods will not be discussed; the title assigned to this paper will permit consideration only of the latter method of laboratory instruction. Undoubtedly

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Summary of Unit Operations Equipment for Proposed Chemical Engineering Laboratory

Equipment	Description	Estimated Cost, Dollars	Experimental Work
Absorption			
Acid proof stoneware absorption tower and auxiliaries	30 in. I. D., 12.5 ft. high	230	Mass transfer coefficients Packed tower, H.E.T.P. or H.T.U.
Packing	Raschig rings, 1 x 1 in.	180	Spray tower
Pump and spray nozzles			Effect of velocity, temperature, free space CO_2-air-Na_2CO_3; air-water NH_3-air-water
Adsorption			
Three steel towers for active carbon or silica gel	Constructed of standard pipe		Efficiency and capacity of adsorbent Temperature and velocity effect Adsorption isotherms, hysteresis Suitable systems: Benzene-air-active carbon; water-air-silica gel
Agitation, Mixing, Emulsification			
100 and 300 gal. tanks with agitators and torsion dynamometers	See White, et al., Trans. A.I. Ch.E., **30**, 570, 585; *Ind. Eng. Chem.*, **24**, 1,160, **25**, 1,025		Test of equations for power consumption Effect of variables
Colloid mill	3 in. laboratory size	245	Stability and breakdown of emulsions
Crushing and Grinding			
Jaw Crusher	4 x 6 in., no motor	225	Comparison of mills on same material
Crushing rolls	9 x 9 in., no motor	350	Power consumption
Disk mill			Size distribution in product
Ball mill	24 x 30 in., with motor	410	Test of "laws," see Screening
Gyratory crusher	2 in. feed, ⅜ in. product	385	
Distillation			
12 in., 30 plate bubble cap column and still*, **or**	100 gal. steel kettle	1,850	Batch distillation Continuous distillation Effect of reflux ratio on product composition
14 in., 30 plate bubble cap column and still*, **or**	4 caps, 1 downpipe per plate; 2 vacuum receivers	1,285	Plate efficiency, effect of rate
15 in., 30 plate bubble cap column and still*	7 caps, 2 downpipes per plate	2,900	Steam distillation
*Note: All equipped for continuous or batch distillation, plate sampling, reflux measurement			
20 gal. simple steam-jacketed vacuum still condenser, receiver, pump	Copper, 3 x 3½ in. pump	450	
Drying			
Atmospheric dryer and auxiliaries	Steam heated	607	Constant drying conditions Rate versus water content
Vacuum dryer and auxiliaries	Steam heated	625	Effect of air velocity Effect of humidity on rate
Spray dryer	Not standard in this size		Salt production in spray dryer
Evaporation			
Double-effect salt evaporator	20 and 40 sq.ft. heating area per effect, arranged for single or double effect operation	3,000	Code test of double-effect evaporator Economy and capacity Static head
Wet vacuum pump	6 x 8 x 10 in.	300	Non-condensible gas Production of salt crystals from solution Self evaporation Boiling point raising
Extraction			
Extraction cell		1,250	Time-concentration data Effect of temperature Raffinose from cottonseed meal Tannin from bark

Equipment	Description	Estimated Cost, Dollars	Experimental Work
Filtration			
Recessed plate press	12 in. 10 plates, complete	375	Constant rate and constant pressure filtration
Plate and frame press	12 in. 5 chambers, 3 sets of frames, complete	295	Test of equations
Leaf press	Sweetland type, 7 sq.ft. area, complete	500	Effect of variables Washing methods
Rotary vacuum filter	3 ft. diam., 1 ft. face, complete	2,140	Moisture content of cake Compressible and non-compressible cakes
Basket centrifuge			Filter aids
Fluid Flow			
Orifice meter	Interchangeable orifices	135	Calibration and comparison of meters
Venturi meter			
Thermal meter	Thomas type, 8 or 10-in. line, complete	1,490	Power consumption of meters Pitot, exploration, velocity distribution
Pitot tube			
Volume meter	Dry, iron case, 100 c.f.m.	300	Flow in pipes: Test of Fanning equation
Pressure gages			Friction factor versus Reynolds number
Draft gages			
Blowers	1 @ 400 c.f.m.	88	Critical region
3-in. static pressure	1 @ 1,000 c.f.m.	115	Entrance and exit losses
Pumps,	1 @ 10 g.p.m.	15	Correlation, pressure drop and heat transfer
no motor	1 @ 70 g.p.m.	26	
Scales	1,000 lb. capacity, flush with floor	430	
Tanks	100 gal. wood		
Heat Transmission (see also Evaporation, Humidification)			
Double pipe exchangers	Surface temperature thermocouples		Surface coefficients, bare and insulated pipes
Bare and insulated steam pipes	Several kinds of lagging		Thermal conductivity of insulation
Flat surface radiators			Velocity effect, gas and liquid films
Steam jacketed kettle	15 gal. with agitator	570	Natural and forced convection
Gas fired muffle furnace			Test of film equations Hydraulic radius concept
Steam calorimeter			Cooler-condensers, air in steam
Steam traps	Several types		Correlation, heat transfer and pressure drop
Radiation pyrometer	With recorder	475	Radiation transfer, furnace wall to cooled surface
Thermocouples			Radiation correction in gas temperature measurement
Thermometers			
Humidification, Dehumidification			
Air conditioning installation suitable for laboratory building	Spray type washer, mechanical refrigeration for water cooling	40,000	Tower coefficients for spray washer Per cent humidification Wet- and dry-bulb thermometry Thermal efficiency of refrigerating equipment Heat transfer coefficients
Screening, Settling			
Standard test sieves	Set of 15	70	Size distribution in product from one mill, comparing materials of widely different properties (Trap rock, mica schist, coal, limestone) Total surface determinations, test of "laws" Settling experiments
Mechanical sieve	Rotap type	245	
Thickener	5 ft. diam., 3 ft. deep	385	
Diaphragm pump		70	
Settling box			

this method is of more widespread interest because most institutions have, by force of circumstances, developed their teaching facilities in this direction.

Even though the discussion is limited in this way, there still remain many considerations difficult to encompass in a general paper. The chemical engineering curriculum is sometimes administered as a part of the chemistry department and may be housed with the latter. In some schools it is part of the engineering college, and may be housed separately. Local conditions, therefore, are an important factor in determining whether or not such facilities as library, research laboratories, storerooms, shops and offices are to be included in the chemical engineering building. In the present discussion we shall assume that the building and its equipment are to be used primarily for undergraduate laboratory instruction and research.

In a discussion of building and equipment for laboratory instruction it is necessary to have in mind quite definite objectives toward which the courses are aimed. Particularly will the selection of equipment be made with these objectives in view. In accordance with the modern viewpoint we should adopt the unit operations and the unit processes as our basis. Not all of these lend themselves readily to laboratory study and considerable difference of opinion is to be expected in making a selection for undergraduate courses.

The following list of unit operations is suggested; each one is briefly discussed, in the table, from an equipment standpoint.

1. Absorption.
2. Adsorption.
3. Agitation and mixing.
4. Crushing and grinding.
5. Distillation.
6. Drying.
7. Evaporation.
8. Extraction.
9. Filtration.
10. Fluid flow.
11. Heat transmission.
12. Humidification and dehumidification.
13. Screening, settling.

Not all of these subjects can be thoroughly studied and several, such as 4 and 12, might have to be cur-

tailed because of expense. In the tabulation opposite, details of experimental procedure necessarily have been omitted.

Recommendations for equipment are based not only on our own experience at the University of Illinois, but also on suggestions, laboratory instructions and observations relating to several other institutions. These are gratefully acknowledged. The accompanying table is a condensed summary of the equipment and experimental work which is considered to be adequate for undergraduate laboratory instruction. In most instances, estimates of the cost of the principal items have been obtained from manufacturers and are included. There remains a considerable number of experiments, not involving standard equipment, which can be carried on in apparatus built in the laboratory shop by mechanics and students.

The second phase of this subject of a chemical engineering laboratory deals with the laboratory building. A survey of existing conditions indicates that the majority of schools are seriously handicapped in their laboratory instruction by inadequate space and resulting poor arrangement of facilities. In attacking this problem, it has been concluded that the best and most practical solution for most schools would be a separate building designed specifically for chemical engineering purposes. In the building herewith suggested, no provision is made for library, classrooms, offices or research facilities for the entire teaching staff. By locating the proposed building near the chemistry building these facilities could be most economically provided in many cases. Graduate research could, except for work involving large equipment, be handled in the present quarters now devoted to undergraduate instruction. If funds permitted, the proposed building could, of course, easily be enlarged to house all chemical engineering activities.

One suitable design of laboratory building would be 100 ft. long by 70 ft. wide, providing 16,100 sq.ft. of floor space on three levels, with stairways at each end. The shop, supply, instrument and store rooms would occupy the ground floor level at one end of the building. The shop would be equipped with lathe, drill press, and the ordinary metal working tools and equipment, facilities for carpenter work, welding and pipe fitting. It would be in the charge of a competent mechanic. The instrument room would be provided for the safe-keeping of electrical instruments, thermometers, gages, meters and other similar fragile devices. The supply room would contain oil, grease, paint, pipe fittings, belts, tool room supplies, sieves, and so on. The storage room would provide for bulk supplies, filter cloth, pipe and small equipment. A large bay, 35 ft. by 70 ft. with about 40 ft. headroom, served by a 3-ton traveling crane, would provide for the permanent installation of large equipment such as the double-effect evaporator, rotary vacuum and other filters, absorption tower and auxiliaries, spray dryer, mixing and settling equipment, dryers, and the simple vacuum still. Ample space would remain for additional equipment. A truck entrance to this bay would be desirable. A room 35 ft. by 30 ft. under the first gallery would be provided for grinding and screening work, and should be independently ventilated. The large fractionating column could conveniently be installed so as to pass through a hatchway in the first gallery, to be fed from tanks on the second gallery.

Permanent installations for heat transfer and fluid flow measurements could be located on either or both galleries. Provision would be made for long vertical pipe installations at either the inner or outer side of the galleries by means of gratings set in at the floor level. Such apparatus and any others requiring constant flow could conveniently be fed from constant level tanks located at the roof level. Landing platforms on each gallery would facilitate handling of heavy equipment by means of the crane. Across one end of the building, on the first gallery level, the conference room, office, lockers and showers would be located, and immediately above these, on the second gallery level, the chemical laboratory and the air-conditioning installation. The latter, although primarily intended for experimental work in humidification and heat transfer at low temperatures, would also serve to control atmospheric conditions in the laboratory building.

For such a building, erected in the Middle West, it seems that the unit cost with steel frame construction would be 25c. per cubic foot, making $90,000 a liberal estimate for the building alone. Exclusive of the air-conditioning installation, the equipment listed in the tabulation totals $20,000. The grand total for building and all suggested equipment is $150,000.

Rubber Belting Now Produced by Continuous Vulcanization

AN IMPROVEMENT in the production of rubber power-transmission belting by a new continuous vulcanization process has recently been reported by the Boston Woven Hose & Rubber Co. of Cambridge, Mass. The new process substitutes a continuous rotary vulcanizer for the intermittent flat-bed vulcanizing press that has heretofore been universally employed for the purpose, with, it is stated, important advances in product quality.

Rubber transmission belting consists of several plies of cotton duck impregnated with a rubber compound, generally skimcoated with a thin layer of rubber, and then laid one on the other. The belt is then vulcanized under tension. According to conventional practice this is accomplished on a flat hydraulic press, generally 30 ft. long. Each 30-ft. section, as it is introduced into the press, is given a predetermined stretch and then vulcanized at about 300 deg. F. for a specified time. According to the Boston company it is inevitable in this process that short sections of the finished belt, at 30-ft. intervals, will be given a double vulcanization, and that undue mechanical stresses will be exerted on the fabric at these points, both tending to cause damage. The over-vulcanized areas are said to have a flexing life as much as 40 per cent less than that of adjacent sound areas and to be aged by oxygen more than twice as rapidly.

The new process, essential features of which are covered by patents, is said to produce uniformity both because of the continuous nature of the vulcanization and because the pressure, being applied flexibly, is constant regardless of variations in belt thickness. In addition, complete uniformity of tension during vulcanization is attained without dependence on the human factor as in the past.

What the Safe Worker Wears —And When and Why

By H. G. HIGH
The Grasselli Chemical Co., Inc.
Grasselli, N. J.

Gas-mask jobs should be two-man jobs

IF PROTECTIVE EQUIPMENT for the chemical worker is ever to fill its real place in the chemical industry, the problem of its use must be approached from the personal standpoint. Equipment designed for protection of the individual is to him a rather intimate thing, or a nuisance, depending upon the manner in which its use is put to him. Accordingly, two things should be emphasized at the outset of any discussion of this subject.

The first is that the use of various items of equipment should be mandatory only after a very careful study of the situation, in which is given full consideration of the hazard to the employee. With the sudden appreciation of the needlessness of most industrial accidents, there was a definite tendency to a more or less immature conviction that we must pile upon the individual almost every known device for safe-guarding him. The argument here advanced, to be more specifically mentioned with several individual items of equipment, is that a serious study should be made, and only where the proposed equipment, in the judgment of competent appraisers, is really needed and will really function, should it be insisted upon.

The second primary consideration is the comfort and sanitation involved in wearing protective equipment. During the past several years manufacturers of safety devices have recognized this, probably to a larger extent than have chemical manufacturers whose employees were called upon to use them. Included in comfort to any workman with reasonable self-respect, is the consciousness of cleanliness. Much of the protective equipment required in a chemical plant is worn on the face, and for the sake of essential economy, many articles from time to time must be worn by different men. It seems almost as unfair to ask a man to wear a tight-fitting rubber mask or close-fitting goggles after they have been used by another, unknown to him, without their having been thoroughly and properly cleansed, as it would be to expect sundry individuals to use the same toothbrush.

With these initial premises in mind, a brief discussion of a few of the major items of safety equipment is in order.

Goggles—Without doubt, eye protection transcends all other special needs for the chemical worker. It is not the function of this discussion to advertise any special make of goggles. Three things are required. One is a close fit, without neglecting the comfort to the wearer. The closeness of the fit is required to prevent splashes from above or below, or from the side, from entering into the eye. In the writer's experience this is best obtained in a properly molded cup, although there are some goggles on the market with a rubber frame which have considerable merit. The second thing to watch is ventilation. Even with the use of some of the non-fogging preparations supplied by manufacturers, a poorly ventilated goggle, or one with no ventilation, cannot be worn long without becoming so clouded that it presents greater hazard than the goggle itself can possibly eliminate. For the chemical worker, ventilation through indirect or baffle ports is highly recommended above a plain open screen. The third important consideration is to have a lens large enough to give fairly wide vision. There is no reason why a tempered lens which is quite safe against flying particles should not be standard equipment, as most manufacturers are now furnishing these with very little added cost. Whatever the type of lens, it should certainly be non-refracting, otherwise we shall have serious eye strain and resultant discomfort and disinclination to wear the goggles.

Welders' goggles are of course not peculiar to a chemical plant, but every large chemical plant will have one or more welders in its force. The proper shade of lens should be chosen in consultation with the representative of a reputable manufacturer, and the use should, without exception, be mandatory.. Electric arc welding requires not only protection to the eyes, but to the face as well, and therefore a shield fitted with lenses scientifically designed to protect against the intense ray of the arc should always be used for this purpose.

Respirators—A volume could be written on this subject, and in the end one might only have started an argument. Respirators, if properly chosen, will give safe protection against toxic or abrasive dusts, but contrary

to the opinion of some who should know better, they are absolutely useless against any sort of fumes. The efficiency of the respirator against dust depends upon the filtering medium as well as the tight fit of the face-piece. After very extensive study and tests by the U. S. Bureau of Mines, approval has been given within recent months to several respirators. The best advice that can be given to any prospective buyer, if he has any extended use for respirators, is to limit his choice strictly to those approved by the Bureau of Mines, and to try out various models, adopting as his standard the one which meets most favor with the men who will actually wear them.

Cannister type masks are also on the market which, through chemical reaction within the cannister, absorb fumes or render them innocuous. Where the concentration of fume is very light, or the exposure brief, and the toxicity low, this type of respirator is satisfactory.

It is possible for a manufacturer to design his own air line or respirator, providing the wearer does not have to move along a very wide radius. This can be supplied with air in the plant's compressed air lines through a rubber hose, by the installation of a proper air filter, and a positive reducing valve, insuring not over 4-lb. pressure.

For spray painting and certain chemical operations where not only solid particles, but also certain toxic fumes, have to be filtered out of the air, either the cannister respirator or the air line is preferable to any known type of gauze or wool filter.

With the increasing tendency, not only on the part of compensation agitators, but also sane and conservative physicians, to recognize the positive existence of silicosis and allied ailments contracted through the inhalation of dust, no chemical manufacturer can safely ignore dust conditions under which his men may work. He need not become panicky, but he should frankly recognize the situation, and should meet it with a more practical and intensive study of his dust problems than has been the custom in the past. For this reason respirators assume a major importance, at least until this difficulty has been brought under control.

Gas Masks—These are available in two types, the cannister mask, in which the air is breathed through a chemical filter, with the toxic property destroyed by chemical reaction, and the air-line mask. The cannister mask has definitely limited use. In the first place, it should never be used where there is any danger of deficiency of oxygen. In the second place, its life is of an unknown quantity. Its use should therefore be confined, as far as possible, to emergency repairs during breakdown or rescue work. Under normal conditions the cannister might easily lose its efficiency in an hour or less.

Cannisters are furnished for protection against definite fumes. The manufacturers will gladly give competent advice as to the particular type to use in any case where the nature of the toxic fume is definitely known. There is also the so-called all-service mask, which has merely combined in one cannister a number of reagents, thus insuring protection for a limited time against a fairly wide range of fumes.

The air-line mask is so named because the air is furnished to the wearer through a hose from a blower situated outside the contaminated zone, or is furnished by filtering and reducing the pressure of the plant service air. This mask is slightly more cumbersome to the wearer, but furnishes very certain protection. There is no question about deficiency of oxygen, and the danger of fatigue due to difficulty in breathing, which is always more or less present in the use of the cannister mask, is entirely absent. In entering fume-laden quarters, or a tank or other closed vessel where the presence of fumes is known or suspected, the air-line mask should always be used.

Except in the case of emergency rescue work, a job requiring the gas mask should not be tackled by one man. Especially when entering a closed vessel the employee wearing the mask should also be equipped with a safety belt, and there should be someone at the opening at all times, ready to render assistance through the means of a rope or chain in case of some unforeseen emergency.

At the outset it was noted that personal equipment should be properly cleaned and sterilized. Goggles and respirators are comparatively inexpensive, and yet a great deal of unnecessary expense may be avoided if goggles used by employees who no longer require them, or who leave the company, are turned back into stores and thoroughly cleaned with good soap and water, and thus made fit for issue to another employee. The same practice can be followed in the case of respirators by cleaning the face-piece, if necessary installing new head straps, and, of course, installing a new filtering medium.

The gas mask is seldom a regular article of use for one employee. It is, therefore, extremely important that

Fig. 1. Test the face-piece to make sure it fits and does not leak before entering gas area

Fig. 2. Rubber gloves may be readily tested for leaks, simply by rolling tightly from the cuff

Fig. 3. The average gas mask is not cumbersome; it is simple and easy to wear on any job

it be thoroughly cleaned after each use. Many physicians feel that a thorough washing with good soap, followed by rinsing with clear water, is sufficient sterilization. If this is not considered sufficient, a light bath with some phenol preparation may be easily applied. These masks should be regularly inspected, and preferably a book record should be kept to insure this check. This is the only sure way to avoid a failure in the emergency that calls for the immediate use and complete efficiency of the gas mask. This inspection should include not only the face-piece and hose, but also a mechanical inspection of the blower, and if the blower be electrically driven a competent electrician should check the electrical connections. The approved method for inspecting the face-piece is actually to adjust it on the face of the inspector, and by closing off the air inlet on the bottom, either by pinching the hose, or putting the hand over the cannister intake. In this case the face-piece should collapse against the face if there is no leak. If it does not so collapse it should be thoroughly gone over and repaired before use.

Gloves and Boots—There are a great many locations in a chemical plant where rubber gloves are absolutely required. Their use presumes the fact that the glove protects the hand of the wearer from the chemical. Nothing need be said about the type of glove to be worn, as it may be presumed that it will be sufficiently sturdy without being too stiff and cumbersome. Something should be said, however, about frequent inspection of rubber gloves. A hole in the glove is a serious accident hazard, as the wearer will take more chances when he feels he is safely protected. The simplest way to test a rubber glove for leaks is to roll it from the gauntlet end down (See Fig. 2), and if the fingers do not bulge with the slight air pressure thus developed, a leak is clearly evident. Such a glove should either be discarded, or, in case the leak is clearly visible, repaired, but under no circumstances should the leaky glove be permitted to be used.

A reasonably pliable rubber glove can be turned inside out and thoroughly washed, and thus be fit to pass from one man to another. It should, of course, be closely inspected after it has been turned right side out, to make sure that no cracks have developed in the turning.

Rubber boots are also furnished in some cases for certain special types of work by the employer. The market is now supplied with safety-toed rubber boots, and, therefore, in view of the properly increasing tendency for industrial workers to wear safety-toed shoes, the employer should, to be consistent, furnish only safety-toed rubber boots. As boots will probably be used for but a short time by one individual, and probably then returned to the department office or to stores, they should be cleaned inside as well as out before reissue. Manufacturers have what they call a fusion-lined boot, which can be thoroughly washed on the inside and dried within a few hours, without harm to the lining. Proper consideration of the employee's comfort dictates this sanitary proceeding.

Rubber Suits—There are also on the market rubber suits, consisting of a hood with proper lenses, together with rubber coat and pants, which, when worn in connection with rubber boots, with boot inside the pant leg, and rubber gloves with the gauntlet inside the coat sleeve, gives absolutely complete protection to the wearer in case of unexpected or unavoidable splashes of chemicals. The wearing of such a suit would prevent many serious injuries. It goes without saying that even with the protection of such a suit, no worker should be allowed to go into a location where the condition of air is in doubt, either because of fumes or because it is in a confined space.

A number of other items of personal protective equipment could be mentioned, such as miners' hats, to protect against head injuries from falling material, shin guards, asbestos leggings, and the like. Most of these, however, are not peculiar to the chemical industry. The safety shower, however, while not the temporary or private

property of an individual, should be mentioned in passing. (See Fig. 4.) This is a most effective first aid in the event of an unforeseen acid splash. Accordingly, showers should be placed at carefully selected locations where there is most likelihood of acid burns. They should be installed with a quick-acting valve, with a large enough supply pipe to insure a deluge of water, as even the layman in a chemical plant knows that the best first aid in the case of an acid burn is water, and plenty of it. The showers should always be installed so there is no danger of freezing, and should be tested frequently enough to guarantee immediate operation. Once a shift is not too often.

What has been said in the foregoing should not be interpreted to relieve engineers and designers of the responsibility for installing equipment so that a mass of personal protective equipment is not necessary. This needs to be emphasized, as it is too true that in many cases the full safety of the worker is not given sufficient thought in planning equipment or process.

As has been suggested, the market is well supplied with excellent protective equipment. Provision of this is therefore simpler than the problem of having it used consistently. One remedy for this difficulty has already been suggested, and may well be repeated for emphasis—the limiting of mandatory use of any personal protective equipment to situations chosen only after careful consideration and discriminating judgment. The equipment must also be the most comfortable obtainable, and in practically all organizations, more time and thought could well be spent on showing the employee that it is in his interest, more than to avoid criticism and expense for the company, that the protection is furnished and its use enforced. Or to revert to the thought at the outset: the choice of protective equipment, and the legislation and enforcement of its use, should always have an intimate personal touch.

Fig. 4. Standard type of safety shower used in plants of E. I. du Pont de Nemours & Co.

EDITOR'S NOTE: *Additional and valuable information on protective equipment and safe practices in chemical plants may be obtained on request from W. Dean Keefer, director of the Industrial Division, National Safety Council, 20 No. Wacker Drive, Chicago, to whom Chem. & Met. is indebted for the illustrations accompanying Mr. High's article.*

Sees New Legislation as Threat to Employer-Employee Relations

SPEAKING before the recent Conference on Industrial Relations at Silver Bay, N. Y., L. C. Morrow, editor of *Factory Management and Maintenance*, branded the new National Labor Relations Act as a direct threat to employee-representation plans now in operation in many process industries. "In my opinion," he said, "the act is a green light for organized labor. It sanctions the closed shop. It discourages the non-union forms of employee representation. It does not give free choice of representatives to each worker. It circumscribes the employer by definitions of unfair practice that he will perforce walk circumspectly while his workers are being organized. For the activities of the organizing agencies there are no legal restrictions. These agencies cannot be held responsible financially. They cannot be compelled to live up to agreements, except by force of public opinion.

"Organized labor ever has been willing to make demands, and never has been so modest as to ask for just what it expected to get. It is accomplished in bargaining. According to the act, the employer *must* bargain. If he listens to proposals and says "No," has he bargained? Presumably the new Labor Board will answer that question along with many others. They will exert an extensive influence for either peace or unrest, according to their interpretation of the act, and to their conception of their duties under it.

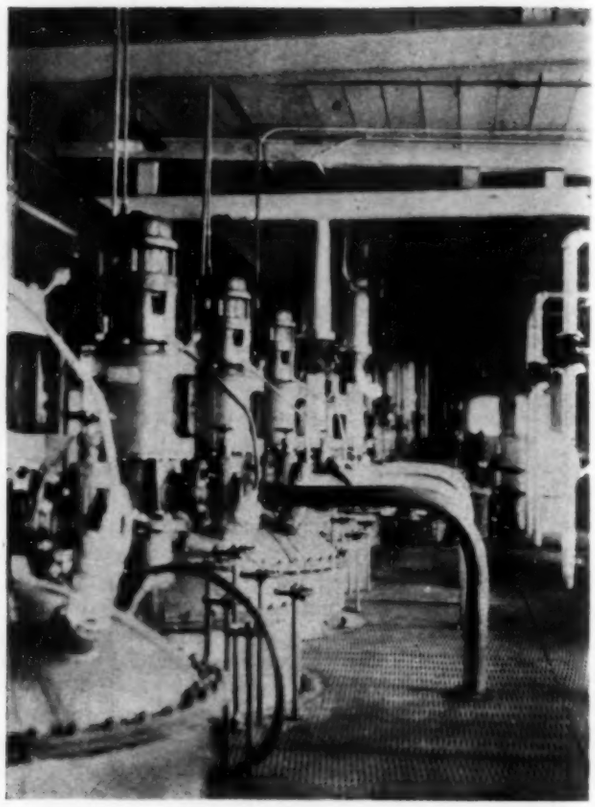
"There was plenty of indication, during the most serious part of the depression, that workers are willing to listen to reason and share in an unavoidable adversity that faces their employer. Is it not logical that they have the same intense interest in the conditions of employers now that they see the prospects of regaining some of the income that they sacrificed in good spirit?

"This kind of educational work was going on under the guidance of our best employee representation plans until all such plans were given a black eye. Possibly it can continue in plants where representation plans were in effect before the National Labor Relations Act became a law. If it is found that the new law cannot be applied to manufacturing (a question about which there is much difference of opinion) there will be a fine opportunity for the representation plans to be increased and educational work to be enlarged.

"If it turns out that the law is universally applicable, I do not see any hope for the future of employee representation plans. It is too much to expect in the average plant, among the workers below foremen, the type of leadership necessary for the initiation, formulation and promotion of a plan. Judgment based on precedent indicates that the Labor Board probably will rule that management must not propose the plan or formulate it. I cannot hold with such a ruling. The objective in labor relations should be to achieve a just and fair relationship. This can be done by means of employee representation."

Producing Phenolic Resins For Casting

By HERBERT CHASE
Forest Hills, N. Y.



Nickel lined processing kettles equipped with nickel agitators driven by vertical motors. Elbows lead to condensers located below balcony

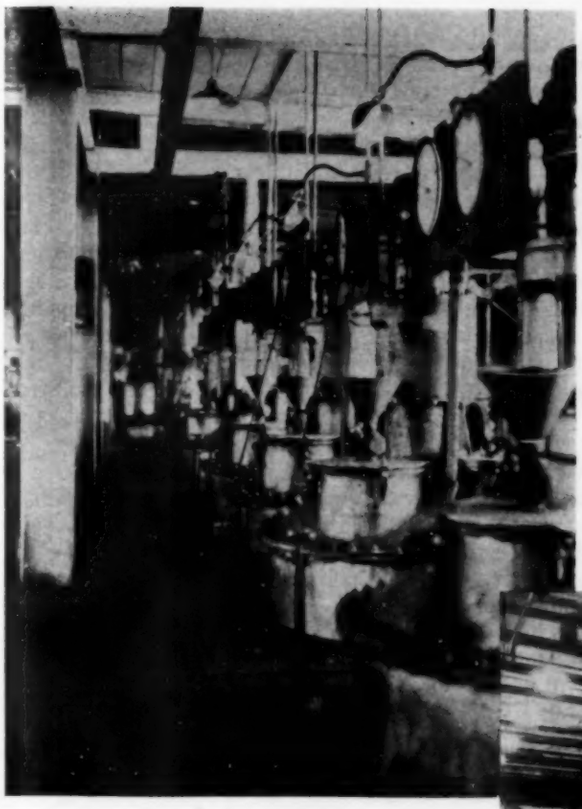
SURPRISING ADVANCES have been made within the past few years both in the production and use of the cast type of phenolic resins, which are similar in a general way to the widely used molding and impregnating types. The cast type attained a production, in 1934, estimated to be between 4,000,000 and 4,500,000 lb. of which the American Catalin Corp. made fully 70 per cent. Its plant at Fords, N. J., which is one of the largest plants devoted to the manufacture of phenolic resins in the world, has a production capacity of about 5,000,000 lb. per year.

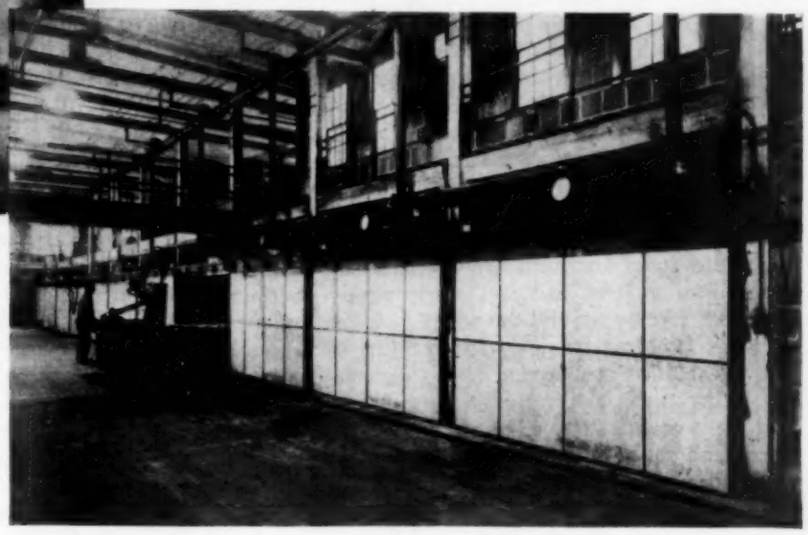
At the Catalin plant operation proceeds continuously on a three-shift basis which is necessary because of the length of the process and other factors involved. Production of the resin in its initial liquid form requires from 8 to 16 hours, and the curing which follows casting ranges from three to six days, so that about a week is needed for the complete cycle in some instances.

When lead molds are filled with resin they are conveyed into a curing oven

The plant includes modern buildings and equipment which is operated under exacting control. All processes are carefully timed and in most instances the control of temperature and pressure is automatic, so that the human element is almost entirely eliminated. An autographic record is kept of the temperature and pressure maintained in the resin kettles and the temperature in the curing ovens, so that the history of each batch is not only closely controlled but easily traced by reference to the records. Each batch of resin is produced according to a schedule, supplied by the chemist in charge, which will provide the particular properties desired in the finished product.

Color, degree of clarity or translucency and character of mottling of the resin must be carefully controlled as a large part of the output delivered in cast form is used for decorative purposes. Several chemists are employed in producing and matching the almost unlimited variety of color effects demanded by the trade. In this connection it is interesting to note that throughout the process temperatures rarely exceed 100 deg. C. This not only gives desirable physical properties in the finished product, but facilitates coloration for it makes it possible to use many dyes which would not be practical if higher temperatures were necessary.





Above is a battery of kettles. Each is fitted with recording instruments giving a graphical record of the pressure and temperature maintained throughout the cycle. On the right is a view of curing ovens. One is being charged

▼

is made up in nickel tanks and a suitable acid solution, subsequently used to neutralize the soda, is mixed in earthen-ware vessels on the charging platform.

Kettles used for processing the resin vary in capacity from 400 to 2,000 lb., the majority being used for making batches of about 750 lb. These kettles have nickel inner shells and joints welded with fine silver. They are conical in shape and are so located that the dome-shaped covers project through the floor of the charging balcony above. The nickel discharge valves at the bottom are located a few feet above the casting floor so that the finished resin may be drawn off into nickel pouring buckets with which the casters fill the molds.

Every part of the kettle which comes in contact with the chemicals or resins, the agitator and its shaft, the goose neck, manhole cover and various other fittings, as well as the inner shell of the kettle is constructed of nickel. The outer shell which encloses the jacket for heating and cooling is steel. Below and back of the kettles on the casting-floor level are condensers of cast iron with aluminum cooling coils. Each condenser is connected at its inlet to the kettle goose neck, and at its outlet to a piston type of vacuum pump. All of these pumps are located on a balcony near the charging platform and each is driven by silent chain or V-belt by an individual motor. Pumps maintain a 29.5 in. vacuum during virtually the entire cooking cycle.

The principal raw materials are phenol and formaldehyde. The former is delivered in special tank cars, that have a pure nickel lining and a steel outer shell, the space in between the two metals forming a jacket which is used in controlling the temperature of the phenol to facilitate pumping. A nickel-lined pump is employed to transfer the phenol from the cars to a glass-lined storage tank in a penthouse above the kettle-charging platform. The latter tank is jacketed in order to control the temperature of the phenol.

Formaldehyde is delivered either in rubber-lined tank cars or in similar motor-truck tanks and is transferred to glass-lined storage tanks in the penthouse, from which it can be drawn off for charging into the processing kettles. The transfer is effected by the same nickel-lined pump used for handling the phenol. Phenol is handled through nickel piping and valves and formaldehyde through aluminum.

Distilled water is prepared in the penthouse and is used for dissolving the caustic soda employed as a catalyst to promote the reaction in the kettles. The caustic solution

The phenol, formaldehyde and other ingredients, are measured in nickel weighing tanks on platform scales, from which they are run into the kettles. A suitable overhead electric trolley handles the weighing tanks and conveys them to and from the kettle being charged.

The newer kettles have flange-mounted, gear-reduction, vertical motors for direct drive of the agitators and are located above the center of the kettle. Each kettle is fitted with a vacuum gage and with recording thermometers which show the temperature of the jacket and of the contents of the kettle. These temperatures are automatically controlled within ± 2 deg. C. A time alarm warns the

operator when each phase of the cooking cycle has been completed so that the change to the next phase, as called for in the schedule, can be made. A potentiometer has been arranged to indicate when the end point of dehydration has been reached. This is a critical point in the polymerization cycle, and has a bearing upon the subsequent rate of hardening of the resin and its viscosity during the pouring period.

Finished resins contain water in colloidal dispersion, but the greater the degree of dehydration, the greater is the clarity of the resin, if other factors affecting transparency are equal. For this reason, the degree of dehydration has an important effect upon the finished product. As polymerization would proceed too rapidly if the resin were left in an alkaline condition, a suitable acid is added in the final stage of reaction to produce the desired degree of acidity. Most of the coloring is done with aniline dyes which are soluble in alcohol and phenol. These and most of the other coloring matter employed are added to the mass in the kettle when reaction is complete. If translucent or opaque colors are desired, some pigment may be employed. Variously mottled effects resembling quartz, marble and other minerals, and certain effects not obtained in any natural product are produced by mixing a pigment, such as titanium dioxide, in a resin of different viscosity than that to be treated and stirring this mixture into the larger volume of clear or tinted resin.

Resin is drained from the kettles in liquid form and delivered to molds by men using dipper-like nickel buckets with suitable pouring spouts. Most of the molds are made from lead and are prepared by dipping steel forms into molten lead and subsequently stripping the shell that freezes around the form. Molds thus made are fitted into holding frames prior to filling with liquid resin and when filled are carried by an electric lift truck into the curing oven. A few molds are made from blown glass and some of the sheet stock made is cast in metal boxes lined with sheet tin or glass.

Small sheets are cast on edge between glass plates or in metal molds. Large sheets are cut from partly cured blocks, while the latter are still in plastic form on a sheet-cutting machine, and returned to the oven for final cure. A large proportion of the castings, however, are rods, tubes and special shapes which are subsequently machined to final form by the purchaser.

After casting, the resin must be cured. Curing is effected by heat treatment in an oven for several days, depending on the resin itself and on the degree of cure required to give proper machining and other physical properties. During the cure, the temperature is maintained constant within a range of 1½ deg. C., the temperature usually being below 100 deg. C. Hot air is delivered at sufficient velocity to give a positive circulation and a uniform temperature throughout the oven. Ovens are fitted with self-sealing metal-clad doors which are lifted by a hoist when the charge is to be removed.

Castings made in lead molds are removed by using a pneumatic hammer, the molds being destroyed in the process. These molds are then thrown onto a conveyor which carries them back into a melting furnace. The latter is fired by butane gas which is delivered in tank-car lots to a storage tank, piped to the building, vaporized and piped to the burner. The molten lead drawn from the melting pot is carried on an electric trolley to dipping tanks each of which has its own burner to keep the metal in liquid form until used. The molds are shown in an accompanying illustration.

Much research is constantly in progress looking toward the development of new types of products such as impregnating resins, which are already available on a limited scale for use with wooden articles. As yet, the types of resins produced by Catalin, are not used extensively for laminating, but some applications of the sheet material to inexpensive backings have found use in architectural work and tests looking toward further applications of this kind are in progress and may provide an important new outlet in the future. Recent developments make it possible to produce Catalin in a form in which the purchaser can do his own dyeing and thus make a variety of colors from a stock of a single light or colorless form.

Aluminum-Plated Steel Developed

THOSE chemical engineers looking for a material of construction with the strength of steel and the corrosion resistance of aluminum will be interested in the new product aluminum-coated steel. Prof. Colin G. Fink of the chemical engineering department of Columbia University, New York, N. Y., and known the world over for his development work on chromium plating, has invented a process for coating steel sheets with aluminum, according to *Metal and Mineral Markets*.

Patents have been granted in the United States, Canada, and in European countries. Commercial production in this country may take place before the end of the year, as preliminary work on the new product is well advanced.

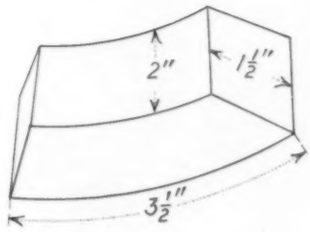
The United States company interested in the process is pictured as an independent organization, not affiliated with either the steel or aluminum industries. The process lends itself to the production of sheets, rods, bars, and shapes. The steel-aluminum plate is ductile, and, according to authorities on the subject, should find wide application in production of airplanes, automobiles, and containers. An air-tight seal has been perfected for cans made of this material, without resorting to soldering.

Interest in this new material is particularly keen in countries now dependent on outside sources for tin. In commenting on the new development the *Deutsche Bergwerks Zeitung* holds that the steel-aluminum plate is a real threat to the tin-plate industry.

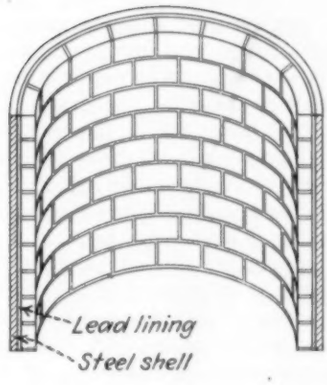
The German publication states that a representative of the patentee, Leopold Frederick, has arrived in Europe with a view to issuing European licenses. A German concern, previously interested in the Ferran patent for coating steel with aluminum, is investigating the new process and may undertake manufacture. Germany is anxious to reduce her imports of tin and foster the use of domestic metals. The coating is claimed to be resistant to acids and is, therefore, applicable to the manufacture of food containers. The paper adds that the process is reported to be cheaper than tin plating. It is declared abroad that the process has caused much disquiet within the Tin Cartel, and even that efforts have been made to buy up the process.

Chemical Engineering Applications of Structural Carbon

By R. S. McBRIDE
Editorial Representative, Chem. & Met., Washington, D. C.



Carbon blocks used to line a tank. The metal shell is sometimes further protected by lead



In this article the author calls attention to the little-known applications of structural carbon and includes information on some new uses of this material of construction that should interest chemical engineers troubled with severe corrosion problems. The new type of low-temperature carbon which is wholly impervious even under pressure, the method of laying the various shapes and the cements come in for their share of discussion.—EDITOR.

CARBON as a material of construction in chemical engineering equipment has numerous advantages. In the past the problem has always been to get the carbon in a form suitable for convenient application, so that the engineer might take full advantage of these advantages. In recent years this material has been made so available.

When used in brick form, as raschig rings, or in other special shapes, carbon is a simple product essentially all in elemental form. The raw materials used are coal, petroleum coke, metallurgical coke, lampblack, and other forms. These are crushed or ground to size, heated repeatedly at high temperature to eliminate volatile matter, and then blended with suitable organic plastic material, such as tar or pitch.

The plastic mass after molding, extruding, or other shaping operation, is baked at sufficiently high temperature to decompose substantially all of the organic matter of the binder. The result is a homogeneous piece of practically pure carbon, of uniform strength and rigidity, highly resistant to chemical attack.

Advantages commonly available through the use of structural carbon in chemical engineering equipment are gained because of the distinctive chemical and physical properties of this element. An accompanying table gives characteristic properties of commercial carbon in structural form. Among the advantages found in practical use are the following:

Advantages of Structural Carbon

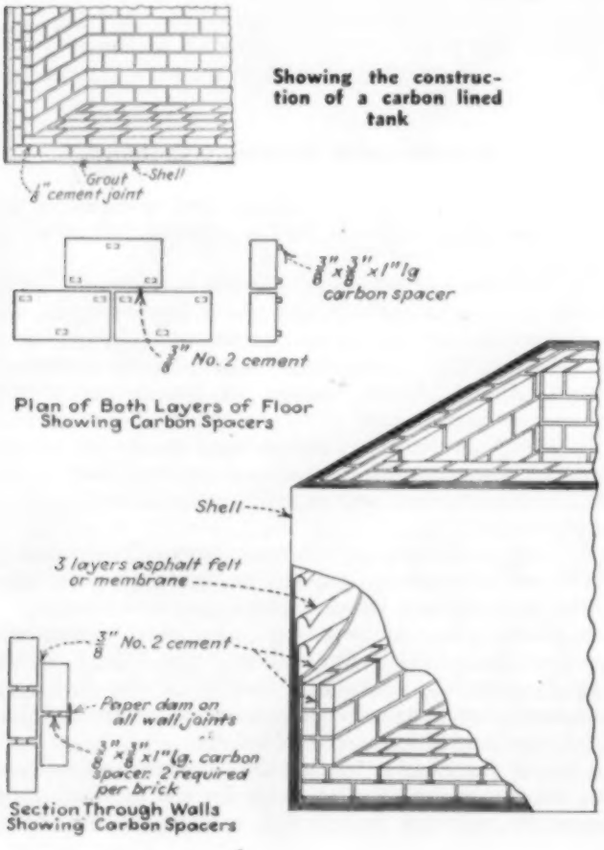
1. Resistance to solvent action, both preserving the equipment when carbon is used as a lining, and eliminating contamination of the contents.
2. Resistance to oxidation, with the exception of air or oxidizing gases at red heat, and a very few strong oxidizing solutions, such as chromic or fuming sulphuric acid.
3. Workability with ordinary tools; can be machined, sawed, planed, drilled, turned, or ground to precise dimensions as required.
4. Low bulk density, which reduces the weight of the structures in which it is used, except where greater thickness is required than with metal in order to secure structural strength.
5. Low coefficient of thermal expansion, reducing likelihood of rupture, spalling, or cracking when subjected to abrupt and frequent changes of temperature.
6. Combination of properties particularly important for tank linings (as contrasted with metal, lead, wood, ceramic materials, or rubber), which creates ability to withstand simultaneously mechanical abrasion, thermal shock, and attack by corrosive liquids.

One of the earliest applications of structural carbon was the use in the form of brick for the fabrication of chemically resistant linings for precipitator chambers,

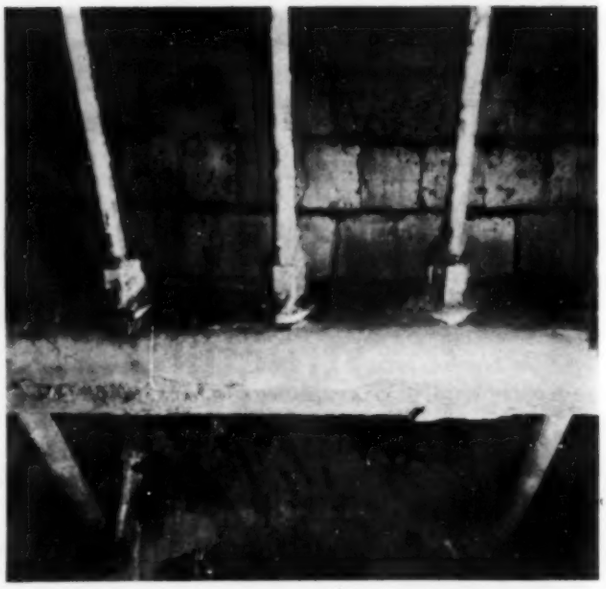
pulp digesters, pickling tanks, reaction towers, and in tubular form for corrosive gas-handling equipment. Where such applications do not require exposure to high temperature and the unit devices are of moderate size, a monolithic low-temperature carbon may be used. More commonly, however, carbon brick laid up with suitable jointing material is preferred.

No carbon brick installation is superior to the joints with which it is laid. And, unfortunately, most carbon-brick linings because of the slight residual porosity of the brick permit traces of seepage. Hence the metal shells lined with carbon brick must usually be further protected as described below against attack by seepage, especially when operated at high pressure which encourages penetration of liquid through the carbon. The newer type of low-temperature carbon is, however, wholly impervious even under pressure and can be used without that limitation if not exposed to temperatures above 70 deg. C.

Brick linings are successful in resisting hydrofluoric acid, as for example in pickling tanks, where mechanical resistance to dragging of bundles of steel is also essential. Phosphoric acid ducts, precipitator tubes, and cooling towers have also been built with carbon which is substantially the only material which resists this concentrated acid at high temperature, especially in the presence of hydrofluoric acid. In the case of paper-plant pulp digesters, carbon linings have particular advantage, not only because of chemical resistance to either acid or alkaline solutions at elevated temperature under pressure, but also because of the high resistance to spalling during sudden temperature changes and the general ruggedness which resists the abrasion by both materials and high-pressure steam.


Grout
Shell
⅛" cement joint
⅜" x ⅜" x 1" lg carbon spacer
⅜" No. 2 cement
Plan of Both Layers of Floor Showing Carbon Spacers
Shell
3 layers asphalt felt or membrane
⅜" No. 2 cement
Paper dam on all wall joints
⅜" x ⅜" x 1" lg. carbon spacer 2 required per brick
Section Through Walls Showing Carbon Spacers

Showing the construction of a carbon lined tank



Interior of the furfural digester showing carbon brick lining

Any of the ordinary cements used in chemical construction can be used to build brick linings provided the cement is stable under the conditions encountered. It is important also that the coefficient of expansion of the cement be nearly as low as that of the brick, if rapid temperature changes are to be encountered. A variety of special cements have been developed, two of which will be described.

Sulphur-carbonaceous cement is especially effective for laying up carbon brick in a fashion that gives safe jointing. It is acid-proof and can be used in practically all plant conditions where exposure is not above 100 deg. C. The cement is applied simply by melting and pouring into the joints of properly spaced brick. Neither hot concentrated sulphuric nor nitric acid attack the cement; but strong alkalis, chlorine, and certain organic solvents which dissolve sulphur, will do so.

In laying carbon brick with sulphur-carbonaceous cement, a full course of brick is set up on small carbon spacers, ⅜ by ⅜ by 1 in. in size, three spacers being used under each brick so staggered as to allow free flow of the cement. A ⅛ in. joint is usually recommended. The cement melted in an open-top drum is poured at 140 to 145 deg. C. with a suitable ladle or lipped can. By starting the pouring in one corner of the tank and moving the ladle along one complete continuous joint (along the 9-in. brick length) the cement will flow down and under each brick completely filling the space. This is evident by the fact that the cement flows up in the next joint.

The second course of bricks is laid on the first with staggered joints, using spacers as in the case of the first course. If the first course has been carefully laid, there will be a slight depression in each joint, approximately a half inch, and no excess cement will remain on the surface of the first course to interfere with the flowing of the cement properly into place about the second course.

Wall bricks are jointed by pouring in cement in much the same fashion as for brick on the bottom of a tank. The open joints on the face of the inside course are

dammed by gluing paper over them to prevent cement from flowing out and down the face of the brick. No special precautions in handling the cement are needed except to prevent local overheating in the heating drum and freedom from unmelted particles at the time of pouring. However, if the cement temperature becomes too high, it becomes gummy and must be allowed to cool before pouring.

In general, two layers of carbon brick suffice for equipment lining. These brick courses are backed by suitable impervious asphalt felt or other membrane material to protect the metal shell against chemical attack by the solutions that might reach it by seepage through the brick. The membrane is inserted as shown in the diagrammatic illustration. It is not essential that this backing membrane be absolutely inert to the attacking chemicals if it be sufficiently impervious to them to prevent penetration of the liquid to the metal.

Properties of Structural Carbon

Real density	2.00-2.10
Apparent density	1.53-1.64
Approximate porosity	25%
Wt. per cu.ft.	100 lb.
Tensile strength	600 lb. sq.in.
Crushing strength	4000 lb. per sq.in. (approx.)
Transverse strength	1000-1500 lb. per sq.in.
Thermoconductivity	0.00786 Cal. per sq.cm. per deg. C.
Coefficient of thermal expansion	0.000,000,72 per deg. C.
Specific electric resistance	0.0042-0.0017 per in. cube
Specific heat	0.2 at 26-282 deg. C.
Volatilization point	3500 deg. C.
Ash	1.00 to 1.20%
Melting point	Not known, but perhaps 4,400 deg. C. under high pressures; at atmospheric pressures it sublimes without melting
Maximum safe temperature under oxidizing conditions	350 deg. C.

Furfural digester lined with carbon brick in the plant of the Quaker Oats Co. at Cedar Rapids, Iowa

Carbonaceous cement is preferred for brick linings wherever it is possible to bake it in place. The resulting structure then becomes practically a continuous piece of carbon masonry. When ready for use, carbonaceous cement is a slightly warm mixture of the consistency of ordinary mortar. It is spread on the brick surfaces with a brick mason's trowel, observing only the precaution that the carbon surfaces are clean and free from dust or other foreign materials. The carbon brick may require wire brushing to insure this condition.

After the brick has been laid up with carbonaceous cement, the joints are allowed to air dry for a period of at least 48 hours. The material is then ready for baking. To accomplish that operation it is necessary that the cement be held between 250 and 300 deg. C. for a short time or the installation will not develop maximum mechanical strength.

Heat may be applied from any convenient source, care being taken that no flame comes in contact with the cement during baking. The rate of heating will vary somewhat with the size of the equipment under construction. In general, the temperature rise should be approximately 10 deg. C. per hr. up to the maximum temperature. Heat applications should be as nearly as possible uniform and not spasmodic.

Control of baking temperatures is best accomplished by having thermometers conveniently placed in the joints at various locations about the equipment. Guess work as to temperature may greatly reduce the effectiveness of the lining produced.

Monolithic carbon construction, previously referred to, is produced by ramming or shaping the carbon mixture on the surface or into forms of the shape required. Commonly, such construction is feasible only when the greatest single dimension of the unit to be formed does not exceed four or five feet.

The monolithic unit so produced has neither seams, cements, or mortar exposure. It is comparatively firm, chemically inert except against a limited number of solvents, and completely impervious to most of the materials encountered in the process industries. However, it cannot be used successfully if exposed to temperature greater than 70 deg. C.

Such linings do not require impervious membrane backing such as is described above as necessary in many cases for carbon-brick linings laid in either sulphur or carbon cements. Hence they may or may not be laid against a membrane such as tar or asphalt-saturated fabric.

To lay up low-temperature lining, the carbon sections or brick are warmed to about 60 deg. C. and the impervious cement troweled on the back of the brick, as well as in the joints. The cement used is resistant to alkali, chlorine, and dilute acid, but it is not recommended for concentrated acetic or mineral acids with the exception of hydrochloric. In laying up such monolithic or quasi-monolithic units with low-temperature carbon cement linings, the cement itself must be heated to approximately 75 deg. C. before use. It should be heated in small batches to prevent drying out or deterioration, which would occur during prolonged heating.

Readers' VIEWS AND COMMENTS

Acetate vs. Direct Acetic

To the Editor of Chem. & Met:

Sir—In your July issue an article appears by Prof. D. F. Othmer, describing the direct production of acetic acid from wood-distillation products. This contributor is the first to print the fact that the best method of treating pyroligneous acid is to distill off the alcohol before neutralizing although he states it has been used for a long time and refers to the present writer's method (U. S. Pat. No. 824,906) of 1906.

Othmer calls attention to the fact that he removes the oils from the side of the column still and produces a strong alcohol in the first operation. The patented method obtains an azeotropic mixture of oils, alcohol and as much water as can be distilled without carrying over acid appreciably, and it thus removes the maximum amount of water from further treatment. This also permits adding "an excess of lime" to polymerize and condense "in the presence of alkali," forming a pseudo "Bakelite." The alcohol produced is so pure it will not "milk" with water in any proportion.

The proposed direct process is similar to that of my U. S. Pat. 835,501 treating the removal of alcohol, settling tar, and distilling the pyro., since the heater of the patent corresponds to the "preheater" of the direct process and must use the same amount of heat, which work was previously done in the old "primaries." The extra work of the direct process is that of the "base heater" working at 250 deg. F. and redistilling the reflux and reboiling the "withdrawing agent" which amount is not determinable. There is also a "stripping column" which redistills the water removed with the "withdrawing agent" not further described.

While the acid from the "pre-heater" is said to be anhydrous yet it is confessed that it is impure in that it contains a "few per cents of impurities" mostly tar and it must be redistilled and refluxed in the "acid column" with silver condenser.

Comparative costs—Elaborate tables are given showing the costs of acetate of lime production and estimates of cost of the direct acid work. The cost of steam per cord is figured as $1.92 but if a wood distillation plant is properly located near a sawmill or charcoal furnace as it should be and works on "by-products" the steam used in the patented process for acetate production may be considered free as the furnace blowing engine or sawmill engine furnishes an abundance of exhaust steam used with multiple effect vacuum apparatus as shown.

We may therefore eliminate this estimated $1.92 for steam for making acetate but it cannot be eliminated from the direct acid cost as the stills cannot utilize exhaust as the "base heater" operates with a distillate of 250 deg. F. and the "preheater" distills off at 215 deg. F.

The manufacture of acetate requires about 50 lb. of lime per cord and there is some labor in drying on the usual floors but drying in rotaries and baking in them to roast off impurities is quite practical and has been used for a long time. This roasting carbonizes pyrogenous impurities.

Acetic acid from acetate of lime — Nowadays most acetic acid from wood distillation is made by treating the acetate in vacuum stills with stirrers, adding sulphuric acid and distilling off saleable acid directly. For the purest acid it may be necessary to redistill in a column with a silver condenser as pictured in the July issue but the amount of steam for this is the same in both cases and may therefore be left out of the comparison. As 100 lb. of acid will decompose 200 lb. of acetate and produce 120 lb. of acetic acid the cost of acid per cord may therefore be figured at about 75 cents.

The writer believes that about $2 per cord in the steam consumption should be allowed in favor of the production of acetate as against acid. The difference in acetate and the direct acid production would be greater than that. If we account for the cost of shipping acid to markets, compared with acetate it will show a balance in favor of acetate. The manufacturers of acid admit the quotations include the cost of packaging, breakage and dangers of shipping acid, while acetate is shipped at low rates.

The essence of the Othmer direct method for producing acid as described depends on the "withdrawing agent," not further identified but it forms an azeotropic mixture with water as do many other non-soluble volatile liquids which have been used for many purposes in the past. The production of anhydrous ethyl alcohol is done on a large scale by using benzol or light gasoline to form azeotropic mixtures of benzol and water boiling considerably lower than alcohol. U. S. Pat. No. 983,784 used water to separate methyl alcohol from chloroform as it was discovered before the work of Young appeared that there was an azeotropic mixture of chloroform and water that boiled below that of methyl alcohol or acetone. As there is a difference of 19 deg. C. between the boiling point of water and acetic acid it is evident that an efficient fractionating column will separate them without the use of any third liquid. This was pointed out by Goering (Ger. Pat. No. 28,064 lately cited by Klar).

Your editorial cited the Brewster patent which was declared invalid and later abandoned and the Suida process, using wood oils. The latter is used in only a few plants although introduced several years ago, in view of the many attempts to produce acid direct, extending over a great number of years and the little success so far achieved, it is not probable that the wood distillation industry will adopt it without a long-time proof of its economy. The expense of installation of the machinery in present struggling plants and a tottering industry will cause hesitation and retard introduction of new processes.

H. O. CHUTE
50 E. 41st St.
New York, N. Y.

Author Othmer Responds to Chute

To the Editor of Chem. & Met.:

Sir—Our good friend Chute wants to remind us that some thirty-odd years ago he also had a process for recovering acetic acid, but as lime acetate. Some things in his remarks show that time has since dulled his memory.

In my article, "Acetic Acid and a Profit From Wood Distillation" in the July *Chem. & Met.*, I twice referred to his process for dealcoholizing pyroligneous—a simple column distillation. It was not my intent to break into print for the first time with anything so startling as a 30-year-old patent. Contrary to his statement, I obtained my information and referred to the drawings in an article he himself wrote on his methods and philosophy. (Trans. Am. Inst. Chem. Eng., Vol. 13, 1920, page 367.)

There is no doubt in the mind of any one familiar with the wood distillation industry *today* that lime acetate is hope-

lessly unprofitable; and given the opportunity and facilities, every operator would gladly change over to acetic acid.

Chute asks that a plant be properly located near a saw-mill (presumably to get its wood waste for nothing) and at a charcoal furnace (presumably to have an infallible market for its charcoal and fuel from the blast-furnace gas for firing the retorts at practically no cost) and furthermore that steam be "free." Then with a river flowing milk-of-lime out in front of the plant and a squadron of "tired business men" doing the labor "for exercise," lime acetate could be made "dirt cheap." Unfortunately, most of the plants can't be moved to Utopia, so that cost estimates there aren't comparable with the direct-acid plant which Mr. Chute unkindly leaves here on earth.

Also my critic expects "an efficient fractionating column" to separate acetic acid and water. While that may be possible in Chute's Utopia, we can calculate that even there it will have to have several times as many plates as the azeotropic plant and use at least three times as much steam. That, of course, is no item in Utopia where steam is "free."

Let's get back to earth, and note that the quoted Goering patent of 1884—which antedates even Chute's process—states that water and acetic through simple distillation *are very difficult* to separate, at a great expense for heat (*"durch blosse Destillation ungemein schwierig zu trennen ist, einen grossen Warmeauswand."*) Why go through 75 lb. of lime—36¢—(Chute's figure of 50 lb. shows we left him back in Utopia) and 75¢ for sulphuric (Chute's Utopian figure) otherwise? This chemical cost—$1.11 per cord—is 75 per cent of the total processing cost for making acetic directly; and is an even dollar higher than the chemical cost in producing direct acetic acid.

All bulk acetic acid is shipped in tank-cars or drums the same as other liquids—and far from the breakage and dangers Chute would have had 30 years ago in glass shipments, the cost of storing, packaging and shipment of acid today is only a fraction of the cost of bagging and shipping lime acetate.

My article left out acetic from calcium acetate because it is "another story" to most wood distillers and because the inclusion of these conversion costs makes the acid from lime so much more expensive than direct acid that any fair observer would realize it *a priori*. Chute neglects the fact that acid from lime acetate comes off containing at least 20 per cent water which means that only a small amount of "the purest acid"—the acid which has most of the present market—can be made, and that the steam consumption to produce it is far greater than that required for the acid at the base of the azeotropic column. The latter is drawn off in as good quality as the acid from the acetate-sulphuric still and is rigorously anhydrous.

Allow that disadvantage to pass and note that Chute compares the pre-evaporator to one in his 30-year-old patent, stating that they do the same work at the same heat expense. Quoting Chute "The extra work of the direct process is (therefore) that of the 'base heater' working at 250 deg. F." Tests show that the base heater takes 5 lb. of steam per pound of acid, and the stripping column—Chute's worry—takes 0.75 lb.

Thus for 5.75 lb. of steam—"free"—in Utopia (about .17¢ per lb. or 22.5¢ per cord in everyday practice), Chute condemns the direct system for a steam cost of 22.5¢ as against his chemical cost which is figured very low at $1.11.

And if he wasn't in Utopia, he would find on the contrary, that in most plants the steam does cost good money and that by direct measurement the total of the steam requirements of the acetate process is about twice that of this direct-acetic process, without any consideration of heat in the sulphuric conversion. And most of the plants don't have multiple effect evaporators, which, to install, would cost a large fraction of the cost of the direct-acid plant.

And when he stops where practically every wood distiller stops, he has $4.20 worth of acetate per cord on which he pays an average of $0.70 freight—if he is able to sell it—while the acid process will give him over $7 on which he pays an average freight of less than $0.50. That is $3.50 versus $6.50, and that means a reasonable profit versus loss.

When it is considered that at the time Chute's patent was granted in 1906, lime acetate was selling for over 10 per cent more than today's price; and that there has been a tremendous increase in costs of production and of most commodities in these three decades, it is obvious that some change in processing is imperative.

Those contemporary with Chute's work in wood distillation still regard that period as a Utopia; but fortunately some of them can see things in the stern light of present-day conditions.

D. F. Othmer
99 Livingston St.,
Brooklyn, N. Y.

Finds Profits in Direct Acetic Recovery

To the Editor of Chem. & Met.:

Sir—It is a matter of common knowledge that the wood distillers have been hard hit, especially in the last few years, by having to compete with synthetic products but the most dangerous threat to the life of the industry is the fact that so many of its members are laboring under the same misconceptions as Mr. Chute.

There is very little point to an argument based on detailed costs of making either acetate or acid. Regardless of the accounting system used, the cost of the individual products of wood distillation is based on arbitrary allocations of all items of general expense so there is no way to arrive at an accurate cost of any one product. The cost of processing a cord of wood, however, can be, and is, definitely determined and the final answer as to whether a plant can afford to operate or not depends on whether the income from sales of all the products exceeds this processing cost.

Close personal contact for several years with the operations of two 80-cord plants making acid by the Suida process and with one 160-cord plant making acetate warrants the statement that the processing cost per cord of wood is *lower* and the sales value of the products is *higher* for the direct-acetic acid plants than for the one making acetate. The cost sheets show it and there is money in the bank to prove it.

There may possibly be one or two exceptions but available records indicate that the only wood distillation plants which have operated continuously at *full* capacity over the last five years were *not* making acetate. That fact should mean something to the members of the industry who still seem to think, along with Mr. Chute, that the advantages of direct acetic recovery have not been demonstrated.

T. C. Albin
Chemical Engineer
Forest Products Chemical Co.,
Memphis, Tenn.

Acid Shipper Makes Suggestion

To the Editor of Chem. & Met.:

Sir—Replying to the request in your May issue (page 270) for suggestions for the clarification of I. C. C. regulations on shipping containers, I should like to refer to specifications Nos. 103 and 103A, paragraph No. 14, specifying safety devices to be used on tank car domes.

On tank cars used for the handling of sulphuric acid, there is no reliable way to provide for release of internal pressure with a spring pop valve, on account of the corrosive nature of the lading. Springs lose their tension, and the valve sticks in the seat.

The frangible disk method of relieving pressure is employed. Necessarily, these disks have to be made of lead, a

relatively non-corrosive metal, and are rather thin. Slight pressures deform the disk to a dome shape, thinning the lead to a point where rupture subsequently takes place at a much lower pressure than that required to create the bulge.

An open vent, with suitable quick draining baffles to prevent any acid sloshing about in the dome from splashing through the opening, would be much safer in every way than the frangible disk. The internal pressure would never exceed atmospheric, and such hazards as exist in opening a car under pressure would be completely eliminated.

Hazards to railroad employees would also be eliminated, because casual inspection will not reveal a ruptured disk, and the lack of baffling endangers the trainmen to splashing.

Sulphuric acid shippers are in accord in the belief that the use of frangible disks on tank cars creates a greater hazard than the old open type vent, as the hazard from splashing was exceedingly small, and such as did exist would be completely eliminated by baffling the opening.

PLANT MANAGER
Established Chemical Co.,
New York, N. Y.

All-Welded Steel Evaporator

To the Editor of Chem. & Met.:

Sir—During the last few months announcements have been published in various technical magazines of this country telling about an all-welded steel evaporator with copper tubes to be used in connection with evaporating a saturated sodium-chloride brine in order to produce salt for general purposes.

To the writer's way of looking at it, this may prove a black eye for the all-welded construction. The article states that these are the first such evaporators built in the United States and they may be the last ones for some time to come if some one does not find a means to overcome or control the electrolytic action that will occur in this apparatus under such conditions.

It will be of interest to the engineering profession, therefore, to watch this installation closely. We do not get an opportunity very often to study the destructive effects of electrolytic action under such ideal conditions in such a large apparatus and we sincerely hope that the Diamond Crystal Salt Co. of St. Clair, Mich., will give the engineering profession an opportunity to measure the potential differences at various parts in this apparatus. Judging by past experiences the machine may not last six months, and it is sincerely hoped that the owners will take every necessary precaution.

There are indeed many places where all-welded steel construction is an outstanding advantage over the use of cast iron, and with the development of the new metals under the direction of capable engineers such construction is a considerable step forward. At the present time, however, it is doubtful if any material is available from which a salt evaporator could be constructed which would be more economical and have greater lasting qualities than cast iron in conjunction with copper tubes as a heating surface.

MARTIN J. KERMER
Chief Engineer,
Buffalo Foundry & Machine Co.,
Buffalo, N. Y.

Ferrous and Non-Ferrous Alloys

Editor's Note: In the July issue of *Chem. & Met.* a compilation of corrosion resistant metals and alloys, classified by composition, was published. Unfortunately, a few errors crept into the long listing and have been called to our attention through corrective comments from *Chem. & Met.* readers.

Tophet D, manufactured by the Wilbur B. Driver Co., contains 30 per cent nickel and 20 per cent chromium.

Cop-R-Loy is manufactured by the Wheeling Steel Corp.

Toncan Iron manufactured by the Republic Steel Corp. should be classified as a copper bearing iron. It contains 0.40 per cent copper and 0.05 per cent molybdenum.

Some New French Plastics

To the Editor of Chem. & Met.:

Sir—Having seen in the introduction to the Chem. & Met. Directory of Plastics, published in the November, 1934, issue, that comments on this material would be welcomed I am sending notes on two of the items.

Wandrite was developed by the inventor, Wandrowsky, who claims that it is equally as impervious to water as is leather; consequently, it is useful for such purposes as soling shoes, for a water-proof wrapping, as a substitute for oil cloth. Ethers or esters that are insoluble in water, particularly nitrates and acetates, are added undissolved to mascerated paper. After drying the mass it is treated with a solvent which is used in very moderate proportion and which dissolves the ether or ester added to the paste and completely penetrates the paper or cardboard. After evaporation of the solvent the fibers are found to be covered by an impregnable cement of cellulosic ether.

Isolemail is a synthetic resin of the Bakelite type, invented by Jean Filhol of the Societe des Laques & Isolants, at Lyons, France. By the use of special catalysts the inventor arrived at interesting products of really original formulas. For condensation of phenol-formaldehyde mixtures he first used an alkaline catalyst, basic phenolate of ammonia, then an acid catalyst (4-5 per cent) ethylene bisulphite, which, like acetylated phenol, is also susceptible to polymerization, giving a product suitable for mixing with cellulose acetate. (Fr. patent 510,116 and 521,522, 1919.)

AM. MATAGRIN
Chindrieux (Savoie),
France.

RESEARCH IN THE EFFECT OF OPERATING TEMPERATURES ON THE COMBUSTION OF INDUSTRIAL GAS. Report No. 748. Published by American Gas Association, Cleveland, Ohio. 77 pages.

CONTAINS original information concerning a large number of variables influencing the operating temperatures and combustion of industrial gas. The data presented apply exclusively to furnaces operating with oxidizing atmospheres.

AUSFÜHRUNG POTENTIOMETRISCHER ANALYSEN. By *Werner Hiltner.* Verlag von Julius Springer, Berlin. 141 pages. Price, 6.60 Rm.

POTENTIOMETRIC analysis is based on concentration changes during titration which may be easily followed by continuous potentiometer readings. One of the advantages offered is, that determination of the various components of complex mixtures may frequently be accomplished without the elaborate methods of separation generally required in ordinary analytical procedure. This little volume discusses the relation between concentration and potential, and the common types of apparatus and electrodes developed for this work. Specific examples have been given for a large number of elements, with detailed instructions that may easily be followed by the manipulator.

THE PHYSICAL CHEMISTRY OF STEEL MAKING. A series of investigations by *C. H. Herty, Jr., and associates.* Price, $3.

BIBLIOGRAPHY of Non-Metallic Inclusions in Iron and Steel. Compiled by Lois F. McCombs and Morris Schrero. 308 pages. Price, $4.

BOTH volumes are published under the auspices of Carnegie Institute of Technology and Mining and Metallurgical Advisory Board, Pittsburgh, Pa.

MITTEILUNGEN, KAISER - WILHELM - INSTITUT F. EISENFORSCHUNG, DÜSSELDORF. Vol. 16. Published by Verlag Stahleisen, Düsseldorf, Germany. 239 pages. Price, 27 Rm. bound.

TWENTY ONE papers covering a wide variety of subjects ranging from almost pure chemistry through metallurgy, strength of iron and steel, and plastic flow to purely mechanical properties of iron and steel.

Chemical Engineer's BOOKSHELF

Making and Using Motor Fuels

PRINCIPLES OF MOTOR FUEL PREPARATION AND APPLICATION. VOL. II. By *Alfred W. Nash* and *Donald L. Howes*. Published by John Wiley & Sons, Inc., New York City. 538 pages. Price, $8.

Reviewed by *W. L. Nelson.*

THE PRESENT VOLUME will probably be of far more interest to chemical engineers in petroleum refineries than Vol. I which was reviewed in the May issue of *Chem. & Met.* Almost the entire volume is devoted to discussions of performance characteristics of motor fuels in internal combustion engines. Although the processing and engineering problems of petroleum refining are of great interest, the real purpose of the industry should be to produce products which will serve particular commercial needs.

However, few studies of the performance characteristics of petroleum products were conducted prior to 1926. In this volume the authors have admirably reviewed the mass of data that has been accumulated since that time. The reason for the delay in the study of the practical performance of petroleum products has been due, in part, to the discouraging multitude of uses for petroleum itself and perhaps to a greater degree, the difficulties encountered in analyzing and evaluating the oil before and after it has been used. To this writer's knowledge, this is the first book that has consistently adhered to a discussion of the performance of motor fuels in terms of the physical properties of the fuels themselves.

A tremendous amount of experimental work and current literature has accumulated during the last ten years concerning the effects of sulphur, gum, volatility and knock rating on the performance of motor fuels. The authors have performed a real service for the industry in reviewing and critically cataloging this information. Likewise, the specifications of motor fuels have been standardized during recent years and these developments have been faithfully traced from 1917 to the present time. The extensive use of automotive diesel engines in Europe is pointed out and the authors feel that this type of engine will be used to a far greater extent in the future.

Vol. II is a real contribution to the petroleum industry and it is a matter of regret that the authors could not also discuss the performance and characteristics of heavy oils.

Nitrogen Chemistry

THE NITROGEN SYSTEM OF COMPOUNDS. By *Edwin Curtis Franklin.* American Chemical Society Monograph. Reinhold Publishing Corp., New York. 338 Pages. Price, $7.50.

Reviewed by *F. W. Miller, Jr.*

"THE FIRST PURPOSE is to present the knowledge available upon the topic in readable form. . . . The second purpose is to promote research in the branch of science covered by the monograph, by furnishing a well digested survey of the progress already made in that field and by pointing out directions in which investigation needs to be extended." The ideas indicated in these extracts from the General Introduction to the Monograph Series have been ably carried out by Professor Franklin, and in addition he has adhered admirably to his own expressed object of pointing out the striking similarities between the so-called oxygen and nitrogen systems of compounds.

In a book of this type, consisting in large part of a great number of typical and unrelated reactions, it is relatively easy to become lax in pointing out similarities between two systems of compounds, particularly where the parallelism seems obvious because of earlier illustrations. Whereas such laxity may be excusable in the eyes of a specialist in the field, much of the book's value may be lost to the reader whose interests are primarily along a different line but who may wish to refer to such a book in studying an isolated group of compounds. It seems clear throughout that Franklin has zealously kept the latter's point of view in mind.

After several introductory chapters on the properties of liquid ammonia, its function as a solvent, nomenclature in the nitrogen system and a discussion of nitridation (termed "augmentation") as the analog of oxidation, the author proceeds with a discussion of the preparations, reactions and properties of 28 classes of nitrogen compounds, referring where possible to the aquo-analog and including therein a record of a very large number of individual compounds with their preparations. The latter fact in itself should make the book valuable to the nitrogen chemist as a reference work.

The book meets a real need in collecting under one head for the first time in English the accumulation of over a half century of work on liquid ammonia. Most text references to this subject to date have been sketchy at best, so that the reader has been forced to the time-consuming process of consulting a series of original references to locate information on a particular subject in this field. He will be spared much of this effort by the completeness and organization of this work.

The bibliography offered is an excellent one, though it was surprising to find, when the space devoted to the subject of liquid ammonia as a solvent is considered, no references to the quantitative measurements of solubilities which have been done in the recent years.

The well-written, profusely illustrated and thoroughly detailed description of the technique of handling reactions in liquid ammonia, as given in the appendix, should prove a real aid to those who already have had some experience in this field as well as being invaluable to those contemplating such work. The inclusion of several actual examples of compound preparation is another indication of the general thoroughness to be found throughout.

In summary it may be said that the book is an admirable digest of work in a field almost exclusively American and in which the author was one of the pioneers and is undoubtedly the outstanding contributor.

Comfort Conditioning

LEWIS' NEW AIR CONDITIONING FOR COMFORT. Second Edition. By *Samuel R. Lewis.* Published by Keeney Publishing Co., Chicago, 1935. 277 pages. Price, $2.50.

Reviewed by *T. R. Olive*

AIR CONDITIONING, particularly as it pertains to human comfort as distinguished from its purely utilitarian aspects, has advanced far since the appearance of the first edition of this book in 1932. As a consequence, the author has found it necessary completely to rewrite the earlier work, supplying much new material which adds greatly to its usefulness.

Mr. Lewis, who is a past president of the American Society of Heating and Ventilating Engineers and an air conditioning consultant of repute, has done

an excellent job in clarifying a subject which is certain to be so much Greek to the layman, and even decidedly hazy to the engineer who has only infrequent occasion to deal with the control of air properties. Although the book is written to be intelligible to the non-technical reader, this should prove no deterrent to its use by the average engineer. The latter will often be grateful to the author for the simplicity of the style, unless daily use of the psychrometric chart has inured him to its complexities.

As its title indicates, the primary emphasis of the book is on conditioning for comfort. To this end chapters on the physiological aspects of air conditioning and on the actual calculations applying to the year-around conditioning of a residence and a commercial building are included. However, everything in the discussion has its parallels in industrial practice. Its chapters on definitions, conditioning systems, the psychrometric chart, calculations, humidification, dehumidification and refrigeration, heat transmission, ventilation, air distribution, heat sources and heating are as useful to the industrial designer as to the residence architect. To all engineers who wish to gain a quick, workable and reasonably complete knowledge of the subject the book, therefore, is recommended.

METALLIC ARC WELDING. By *H. Harris.* Longmans, Green & Co., New York. 199 pages. Price, $6.

WITH the rapid growth of metallic arc welding during the last decade the possibilities of this process is attracting much attention and its use is being extended to many new fields. The primary object of this book is to summarize the present knowledge of the subject. The major part of the space is devoted to the welding of mild steel. Where information is available the discussion has been extended to alloys and alloy steels, but in this field much research remains to be done before a real understanding can be reached. Space is also given to some of the achievements of the art of welding.

HEAT TREATMENT AND METALLOGRAPHY OF STEEL. Second Edition. By *Horace C. Knerr.* Published by the author. 161 pages. Price, $3.50.

A SERIES of the author's articles for the technical press, arranged as a text for the evening metallurgy class at Temple University, to simplify and clarify some of the complex problems involved in the modern use and treatment of ferrous and non-ferrous metals. Many corrections and additions have been made in the new edition.

TINPLATE AND CANNING. A STUDY OF THE YELLOW STAIN ON TINPLATES. TINPLATE: SOME FUNDAMENTAL CONSIDERATIONS. Three pamphlets of the International Tin Research and Development Council. Free upon request.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Munitions Inquiry. Hearings before the Special Committee Investigating the Munitions Industry, U. S. Senate, 73rd Congress, pursuant to S. Res. 206. Parts 11 and 12, dealing with chemical preparations following the War, and international connections in the chemical industry respectively, are available.

Index to Publications of the Division of Commercial Laws, by Guerra Everett. Bureau of Foreign and Domestic Commerce, mimeographed.

Chemical Developments in Foreign Countries, 1934. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 824; 5 cents. This is a supplement to Trade Information Bulletin 823.

Balance of International Payments of the United States in 1934, by Amos E. Taylor. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 826; 10 cents.

Industrial Machinery in Principal Foreign Countries. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 825: 10 cents.

Code-Sponsoring Trade Associations, by C. Judkins. Bureau of Foreign and Domestic Commerce, Market Research Series No. 4; 10 cents (available from Bureau of Foreign and Domestic Commerce only).

Check Sheet, Introduction of New Industrial Products, by O. C. Holleran. Bureau of Foreign and Domestic Commerce, Market Research Series No. 6; 5 cents (available from Bureau of Foreign and Domestic Commerce only).

Factors Affecting Foreign Trade Policy, Bureau of Foreign and Domestic Commerce; mimeographed.

Consumption of Pulpwood and Production of Wood Pulp. Bureau of Census, Census of Forest Products, 1934; mimeographed.

Standard Samples Issued or in Preparation by the National Bureau of Standards. Supplement to National Bureau of Standards Circular 398, issued February 18, 1935.

Yearbook of Agriculture, 1935. Department of Agriculture; $1.00 (cloth), 762 pages.

Chemical Studies of Infertile Soils Derived from Rocks High in Magnesium and Generally High in Chromium and Nickel, by W. O. Robinson and others. Department of Agriculture, Technical Bulletin 471; 5 cents.

Naval Stores, 1934-35, Annual Report on Production, Distribution, Consumption, and Stocks of Turpentine and Rosin of the United States, by F. P. Veitch and J. E. Lockwood. Bureau of Chemistry and Soils; mimeographed.

National Pulp and Paper Requirements in Relation to Forest Conservation. Senate Document 115, 74th Congress; 10 cents. Letter from the Secretary of Agriculture.

Doctors' Theses in Education, by Ruth A. Gray. Office of Education Pamphlet No. 60; 10 cents. A list of 797 theses deposited with the Office of Education and available for loan.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Acid, acetic (technical), O-A-76; Aluminum - potassium - sulphate (potash - alum), for photographic purposes, O-A-421; Hydroquinone (paradihydroxybenzene), O-H-886; Filler, wood, paste, TT-F-336; Tar, refined, mixed-in-place construction for roads, R-T-136; Copper-nickel alloy, bars, plates, rods, shapes, sheets, strips, tubing (seamless), and wire, Navy Spec. 46M7e; Remover, paint and varnish (organic-solvent-type), TT-R-251; oil, lubricating, marine-engine, compounded, VV-0-541; oil, lubricating, marine-engine, mineral, VV-0-551; Oil, lubricating, refrigerating-machine, VV-0-581; oil, lubricating, steam-cylinder, compounded, VV-0-601; oil, lubricating, steam-cylinder, mineral, VV-0-611; Oil, lubricating, turbine, dynamo, and high-speed-steam-engine, VV-0-661; 5 cents each.

Theoretical Metallurgy, by K. K. Kelley and C. T. Anderson. Bureau of Mines Bulletin 384; 10 cents. Part IV of a series, relating to metal carbonates-correlations and applications of thermodynamic properties.

Detector for Quantitative Estimation of Low Concentrations of Hydrogen Sulphide, by J. B. Littlefield and others. Bureau of Mines Report of Investigations 3276; mimeographed.

Silicosis. The Effects of Exposure to Dust in Two Georgia Talc Mills and Mines, Public Health Reprint No. 1669, 5 cents; Determination and Control of Industrial Dust, Public Health Service Bulletin 217, 15 cents; List of Devices for Respiratory Protection Approved by the U. S. Bureau of Mines, by W. P. Yant, Bureau of Mines Information Circular 6845, mimeographed; Review of Literature on Effects of Breathing Dusts With Special Reference to Silicosis, Part II-A, Chapter 4, Prevention of Dust Diseases (Sections 1 and 2), by D. Harrington and S. J. Davenport, Bureau of Mines Information Circular 6840; mimeographed.

Review of Literature on Effects of Breathing Dusts With Special Reference to Silicosis, Part II-B, Chapter 4, Prevention of Dust Diseases (Sections 3, 4 and 5), by D. Harrington and Sara J. Davenport. Bureau of Mines Information Circular 6848; mimeographed.

Gold and Silver, by Edmund S. Leaver and others. Bureau of Mines Report of Investigations 3275; mimeographed. Contains chapters on: Amalgamation and cyanidation; amalgamation during fine grinding of gold ores; flotation of gold, effect of sodium sulphide; form and occurrence of gold in pyrite from a metallurgical standpoint—coated gold; investigations of southern gold ores; auriferous black sands of the Pacific Coast; flotability of lead and silver jarosites.

Manometry of Explosions, by H. F. Coward and M. D. Hersey. Bureau of Mines Report of Investigations 3274; mimeographed. General survey of the problem and comparison of piston-type with diaphragm-type manometers.

Mineral production statistics for 1933—Separate pamphlets from 1934 Minerals Yearbook on: Gold and Silver, by J. P. Dunlop, 5 cents; Natural Gasoline, by G. R. Hopkins and E. M. Seeley, 5 cents; Stone, by A. T. Coons, 5 cents; Coal, by W. H. Young and others, 10 cents; Crude Petroleum and Petroleum Products, by G. R. Hopkins and A. B. Coons, 10 cents; Gold, Silver, Copper, Lead and Zinc in Montana, by T. H. Miller, 5 cents.

Mineral production statistics for 1934—preliminary mimeographed statements from the Bureau of Mines on: Barite and barium products; gold; silver; phosphate rock; iron; road oil; asphalt; abrasive materials; copper; coke and byproducts; gypsum. The bound volume assembling this and like material on other mineral commodities in printed form is announced for delivery probably late in September, price $2.00, cloth bound.

Rare Earths, by Alice V. Petar. Bureau of Mines. Information Circular 6847; mimeographed.

Mineral Trade Notes. A monthly mimeographed summary is being issued by the Economics Branch of the U. S. Bureau of Mines to transmit notes and comments on economic and trade aspects of various metals, industrial non-metallic minerals, and semi-processed mineral commodities. Those desiring to receive this report regularly will be supplied without charge on written request to the Bureau of Mines, Washington, D. C.

News of EQUIPMENT

Centrifugal Bowl Mill

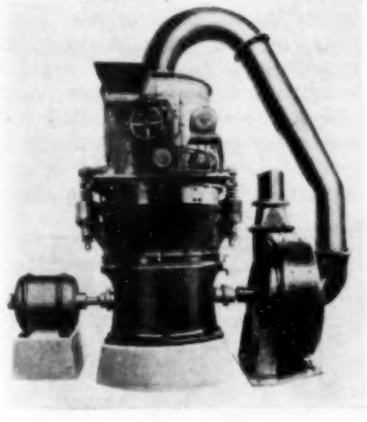
A distinctly novel pulverizer design appears in the new Raymond Bowl Mill which has been announced by Raymond Bros. Impact Pulverizer Co., 1302 North Branch St., Chicago, Ill. The new construction is said to impart remarkably smooth running qualities and quietness to the mill through the use of perfect balance, massive construction, automatic lubrication and the elimination of metal to metal contact.

The unique feature of the mill is a revolving bowl or grinding chamber with sloping sides which serves as the grinding ring. The rolls, the shafts of which are stationary with respect to the ground, in distinction to the revolving assembly used in the familiar Raymond roll mill construction, are forced outward toward the ring by spring pressure, adjustable during operation, but are prevented from making metallic contact with the grinding ring. The clearance is also adjustable during operation. The bowl revolves on a vertical shaft the bearings of which are lubricated by a continuous circulation of oil.

Under centrifugal action, material ground between the ring and rolls tends to climb up the side of the bowl and as ground particles reach the rim, the fines and intermediate sizes are picked up by an air current and carried into a separator for further classification. Oversize material drops back and re-enters the mill with the raw feed.

According to the manufacturers, the mill is adapted to the grinding of coal for direct firing and for storage systems and is also suitable for pulverizing other non-metallic minerals and various manufactured products. If necessary, hot air may be passed into the grinding chamber for drying.

New bowl mill for coal and other non-metallic minerals



Vapor Pressure Recorder

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., has secured exclusive, worldwide, manufacturing and sales rights for the industrial vapor pressure recorder recently developed by Industrial Engineers, Inc., of Los Angeles, Calif. The new recorder is used in measuring the vapor pressure of any liquid and is said to be particularly applicable in petroleum refineries, where its continuous record of measurement makes possible immediate control, in lieu of the long delayed results obtained from the use of the Reid laboratory vapor pressure test.

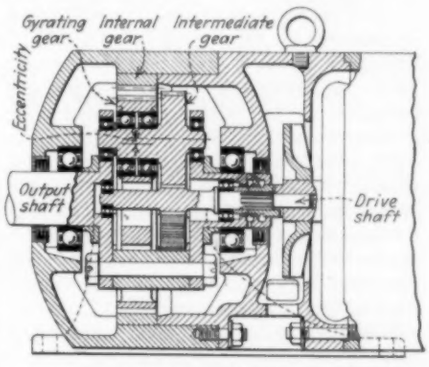
The instrument consists essentially of an accurately controlled constant-temperature bath in which is submerged a cup through which the continuously flowing sample passes. In flowing to the cup, the sample traverses a coil submerged in the bath so that it attains the bath temperature. The vapor pressure in the cup is recorded on a chart, as is the temperature of the bath. An accurate thermostat, cooperating with an immersion heater, a steam coil and a water coil, maintains the bath temperature at 100 deg. F. plus or minus 0.07 deg.

High Ratio Reducers

Three series of speed reducers, giving reduction ratios up to 180 to 1, each series employing a single train of gears, has been announced by Sier-Bath Gear Co., 640 West 58th St., New York City. The first series, comprising ratios up to 20 to 1, employs planetary gearing. The second series, with standard ratios from 20 to 1 to 120 to 1, employs a gyrating principle. A special series with ratios of 120 to 1 to 180 to 1 also employs a gyrating principle. Sizes range from ¼ to 50 hp.

The gyrating mechanism used for the larger reductions is illustrated in the accompanying drawing which shows a cross-section of a motorized reducer. The high-speed shaft carries an integral pinion which drives three intermediate gears that are integral with eccentric shafts.

The three eccentric shafts support a gyrating gear which meshes with an internal gear fixed with respect to the casing. The rotation of the eccentrics causes the gyrating gear to roll within the fixed internal gear, producing a slow forward motion of the gyrating gear which for each revolution of the eccentrics is equal to the difference in the number of teeth between the gyrating gear and the fixed internal gear. As



Cross-section of gyrating type reducer

the eccentrics are supported in the slow speed shaft, this causes the latter shaft to revolve.

All the reducers of this line are stated to have exceptionally high efficiencies, as high as 95 per cent, even under overloads. They are obtainable both in plain and in motorized types, in horizontal and vertical models.

Equipment Briefs

To assure positive and automatic alignment of troughed conveyor belts, the Link-Belt Co., Indianapolis, Ind., has developed a new self-aligning antifriction idler which automatically trains the belt back into a central position on the carrying idlers should it tend to crowd sideways. The new idler, which is used at intervals, is made up of standard belt carrying rolls, mounted on a supporting frame carried on an antifriction pivotal bearing. The ends of the frame support actuating rolls which cause the idler to swivel slightly and steer the belt back to a central position whenever the edge of the belt makes contact with one of these rolls.

Automatic Temperature Control Co., Philadelphia, Pa., has developed a new series of time controls, designed to repeat one or two operations or processes

as often as desired. These controls will handle a repetitive action or operation requiring a definite time period or cycle with either the same or different time periods between successive time cycles. Both the cycle and the interval between successive cycles are infinitely adjustable, with a high degree of accuracy. These controllers are designed for either 110 or 220 volts a.c.

Ring gaskets for grooved joints used on high pressure and high temperature lines, in sizes ranging from 2½ to 14¾ in., have recently been introduced by the Steel Improvement & Forge Co., 960 Addison Road, Cleveland, Ohio, under the name of Gruv-Seal. These gaskets are drop forged and pressed in a coin die, and are produced in either Armco ingot iron or from special acid resisting metals, as may be required.

What is said to be a novelty in X-ray inspection equipment has recently been introduced by the Adrian X-Ray Mfg. Co., 3535 North Palmer St., Milwaukee, Wis., in the form of a fluoroscope-equipped X-ray machine provided with a conveyor belt. Products such as castings, ceramic and plastic objects are carried through the machine on the conveyor belt and viewed in motion through an eye-piece which exposes the fluorescent screen. The machine is equipped with a radiograph attachment for making X-ray photographs.

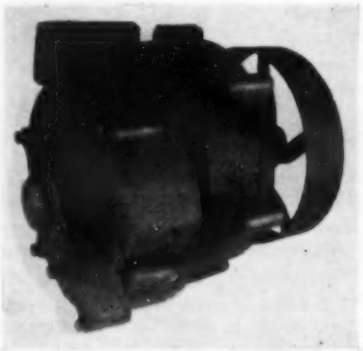
Johns-Manville, 22 East 40th St., New York City, has announced a new light-weight refractory concrete to be cast on the job, the name of which is L. W.-Firecrete. The new product is composed chiefly of high alumina clay, calcined at high temperature, yielding a concrete weighing only 75 lb. per cu. ft. It is recommended for casting light-weight refractory shapes for furnaces in which moderate insulating effect and low heat storage capacity are desired.

Alsop Engineering Corp., 39 West 60th St., New York City, has developed an improved label paster to handle labels of all sizes, shapes and styles at high speed. Features include an enclosed gear drive, an improved glue applicator, and ready accessibility of all parts for washing and cleaning. Another device offered by this company for the attachment of labels, known as the Stixit, consists of a flexible rubber belt connecting two protruding arms that operate on an enclosed gear arrangement. When the label is placed on the bottle and the bottle is pressed downward on the belt, the latter wraps snugly around the bottle, pressing the label firmly into place.

For use where a quick, positive engagement and disengagement are required, the Dings Magnetic Separator Co., Milwaukee, Wis., has introduced a new magnetic clutch said to have less than 1½ deg. slip. The two portions of the clutch are toothed, one side being steel and the other side being bronze. Internal coil springs disengage the clutch. Owing to instant engagement and disengagement, it is stated that "racking" of the teeth is impossible. This type of construction is said to give five times the torque capacity of friction-type clutches of the same diameter.

Shaking Mechanism

What is known as the Shaler Shaker is a new mechanical device for imparting a horizontal shaking or screening motion to a sieve, conveyor or other unit demanding such motion, and manufactured by the Ajax Flexible Coupling Co., Westfield, N. Y. The device consists of two weights geared together so that when one is driven, both weights rotate at the same speed but in opposite



New shaker for sieves and conveyors

directions. The unit is dustproof, oilproof and fireproof. Over 95 per cent of the rotated weight is said to be effective in producing vibration. The unit may be driven either by belt or by direct drive.

This same company has recently announced a helical gear reduction unit, called the "Lectrigear," made in sizes from ¼ to 2 hp. It is used with standard footless motors, without any changes in shaft or bearings.

Electrodeposited Screens

Smooth-surface metal plates containing fine perforations of any desired mesh in any hole size are being produced by a new process recently developed by the Electrolytic Products Corp., 250 West 39th St., New York City. These perforated plates or screens are made by electrodepositing the desired metal, such as copper or nickel or copper and nickel in combination, upon a previously engraved and prepared matrix. The screens may be produced with round holes or with holes that are practically square. They have, so far, been made as fine as 400 holes per lineal inch (160,000 holes per sq.in.). It is stated that even finer screens can be produced if necessary.

Among the advantages claimed for the new process is the fact that there is no iron-clad relation between the size of the holes and the center-to-center distance between holes. In a 120-mesh screen for example, it is possible to supply a hole even larger than 0.006 in. or smaller than 0.001 in., or less. A further advantage is that the screens are absolutely flat and smooth and can consequently be readily cleaned. They can be produced in any desired thickness from a fraction of a thousandth of an inch up to several thousandths of an inch. At present the company is prepared to supply screens in sizes up to 20x24 in. but it will supply larger sizes if desired.

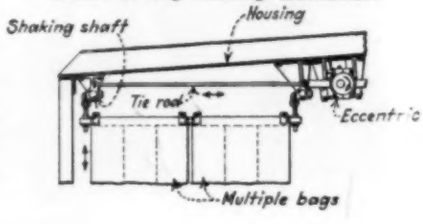
Reset Controller

A new controller, which controls a temperature, pressure, rate of flow or liquid level in a predetermined relation to some other temperature, pressure, rate of flow or liquid level, has been put out by the Taylor Instrument Cos., Rochester, N. Y., under the name of Reset controller. This instrument employs one complete "Fulscope" control system and, in addition, an extra tube system or other sensitive unit. These are separate yet so interconnected that any changes which occur in the "resetting" system are transferred to the Fulscope mechanism as control point adjustments. Both the adjusting and controlled conditions are recorded. An adjustable linkage between the two mechanisms permits any one of a wide variety of ratios to be maintained between controlling and resetting systems.

Multiple-Bag Filter

An extension of the principle employed in the Dracco automatic bag filter has been announced by the Dracco Corp., Harvard Ave. and East 116th St., Cleveland, Ohio, in an improved multiple-bag filter for removing dust from air and gases. The filter elements are tubular cloth bags which require no frame or wire screen for support. This construction is said to be extremely compact and to make possible large filter area in small space. A simple shaking mechanism causes an upward and downward motion of the upper support of the bags and is said to effect almost complete removal of the dust. An im-

Detail of bag shaking mechanism



portant feature, according to the manufacturer, is the fact that when bag replacement becomes necessary, the job is accomplished from the clean-air, rather than from the dusty-air, side of the apparatus.

Vibrating Feeder

For accurately controlled feeding of chemical reagents or for supplying materials to small screens, grinding mills, and so on, the Jeffrey-Traylor Division of the Jeffrey Mfg. Co., Columbus, Ohio, has developed a new

New electric vibrating feeder

electric vibrating feeder known as Type 1-A. This is furnished with or without a vibrating hopper, the latter being recommended for the handling of materials which have a tendency to arch.

The feeder weighs 100 lb. with the vibrating hopper, and 55 lb. without. Its capacity varies with the material fed. For example, with certain granular materials weighing 100 lb. per cu.ft., it will deliver up to 7,500 lb. per hr. without the hopper and up to 4,500 lb. per hr. with the hopper. Capacity is under instant control of a calibrated dial transformer. The full load power requirement is only 30 watts.

Tank Lining Material

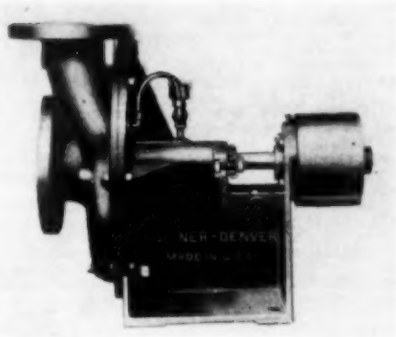
Maurice A. Knight, Akron, Ohio, has announced Pyroflex, a depolymerized colloidal resin which is used as a lining or covering material for tanks and other structures in acid and alkali service. The material is said to adhere firmly to all metal surfaces, to concrete, wood and glass. It will not sag or run at 240 deg. F. yet is flexible at room temperature. It has low thermal conductivity and tensile strength up to 300 lb. per sq.in. at 70 deg. F. The material is supplied in the form of sheets or in bulk and is applied by the application of a cement and heat, by dipping, spraying or pouring while in the molten state, or by troweling as a hot plastic dough, depending upon the particular Pyroflex compound employed. It may be used as a covering without further protection, or it may be combined with a brick or tile lining.

This material is recommended for all mineral acids except sulphuric over 50 per cent, nitric over 7½ per cent, or chromic acid. It is recommended for all alkalis and all sorts of acid salts. It is not recommended for certain organic solvents. It does not resist abrasion.

Side-Suction Pump

A new line of centrifugal, side-suction pumps for general industrial work, for which high efficiency, compactness and simplicity are claimed, has been produced by the Gardner-Denver Co., Quincy, Ill. These pumps are designated Types B and C, depending upon capacity. They are provided with an adjustable thrust bearing and with a heavy-duty ball bearing at the pulley end of the shaft to take the thrust load and belt pull. A grease-lubricated sleeve bearing is used at the impeller end. The pumps are built in sizes from 1 to 3 in. discharge for heads to 100 ft.

This company has also introduced a new line of double-suction, single-stage centrifugal pumps for heads up to 300 ft. These pumps feature exceptionally

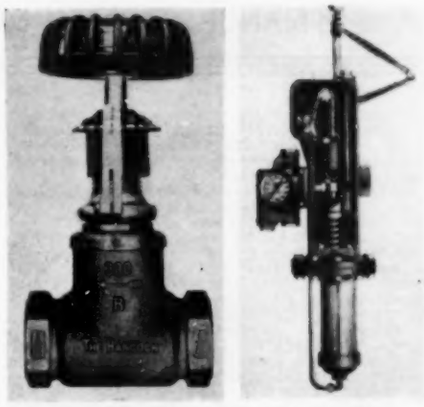


New side-suction centrifugal pump

smooth cast-iron casings, heat-treated alloy steel shafts, extra deep stuffing boxes and heavy-duty outboard ball bearings for thrust and radial loads.

Micrometer Valve

Valve construction of a type making the flow through the valve directly proportional to the number of turns of the handwheel is incorporated in the new Flocontrol valve recently announced by the Hancock Valve Division, Consolidated Ashcroft Hancock Co., Bridgeport, Conn. This is accomplished by means of a special slotted seat. So that the degree of opening of the valve may always be known, an indicator is mounted on the valve showing the numbers of turns and fractions of turns of the valve



Left: Proportional Flocontrol valve
Right: New Cash Type 100 controller

setting. This design is made in globe and angle patterns, in sizes from ⅛ to 2 in.

New Automatic Controllers

Type 100 is the designation of a new series of controllers recently produced by A. W. Cash Co., Decatur, Ill. These controllers come in various types all of which are basically similar to the one shown in the accompanying illustration. They are used to operate balanced valves, dampers, rheostats, pulverizers, fans, and other apparatus.

These controllers consist of an actuating member, such as a diaphragm or lever, a four-way control valve which governs the flow of operating fluid, such as water or air, to a double-acting power cylinder which serves to move the valve or damper to accomplish the desired control. There is also a built-in compensator so designed that a given percentage of change in the condition under control will result in an equal percentage of change in the output of the apparatus under control.

These controllers are said to be extremely sensitive because of the steps that have been taken to eliminate friction. For instance, friction has been eliminated in the diaphragm bearing and in the packing of the four-way valve. The spring load has been suspended so as to eliminate side strains on the valve lever. The controllers are dust proof.

Corrosion Resisting Valves

For handling sulphuric acids, alkalis and other corrosive fluids in a wide range of process industries, The Lunkenheimer Co., Cincinnati, Ohio, has introduced a line of Causul metal valves in screwed and flanged patterns. The line also includes an indicator cock with a diamond shaped port made of the same metal. This metal is an austenitic ferrous alloy said to be particularly resistant to corrosion.

MANUFACTURERS' LATEST PUBLICATIONS

Adsorption. Acticarbone Corp., 25 Broadway, New York City—Pamphlet describing this company's process for recovering gasoline from natural gas.

Apparatus. American Meter Co., 50 East 42d St., New York City—Bulletin AG-2—16 pages on laboratory gas testing apparatus for calorific value, specific gravity, sulphur, ammonia and hydrogen sulphide.

Apparatus. Hevi-Duty Electric Co., Milwaukee, Wis.—Bulletins HD-735 and 835—Respectively covering organic combustion furnaces and hot plates.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 21-B-17—4 pages on positive rotary blowers with information on operating characteristics.

Compressors. Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletin 163—4 pages on steam booster compressors; Bulletin 164, 16 pages on air cushion valve compressors.

Chemicals. The Neville Co., Pittsburgh, Pa.—Reprint describing properties of this company's new plasticizer and solvent oil, Nevinol.

Chemicals. Philadelphia Quartz Co., Philadelphia, Pa.—Bulletin 171—8 pages on types of silicate of soda and uses.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Leaflet 2203—4 pages describing this company's motorized speed reducers.

Equipment. Paul O. Abbé, Inc., Little Falls, N. J.—6-page folder on crushing, cutting, grinding, sifting and mixing equipment for testing laboratories.

Equipment. Alsop Engineering Corp., 39 West 60th St., New York City—Catalog 635—32 pages on liquid handling equipment including labelers, bottlers, filters, mixers and storage tanks.

Equipment. Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J.—6-page folder illustrating types of corrosion- and heat-resisting castings made by this company.

Equipment. Coppus Engineering Corp., Worcester, Mass.—Bulletin 120-3—4 pages describing turbines, ventilation equipment and air filters made by this company.

Equipment. Patterson Foundry & Machine Co., East Liverpool, Ohio—8-page folder illustrating types of mixing and grinding equipment made by this company.

Equipment. Swenson Evaporator Co., Harvey, Ill.—Bulletin E-135—47-page completely revised reprint of this company's series on "Heat Transfer and Crystallization" prepared by Prof. W. L. Badger with the assistance of H. B. Caldwell and G. E. Seavoy. Also 12-page booklet briefly describing, with flow sheets, equipment for evaporation, crystallization and filtering made by this company.

Equipment. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Bulletin L-611-B3A, Steam booster compressors; L-800-B1, Air lift pumping systems; W-103-B1, Horizontal duplex piston pumps; W-316-B3, Vertical sewage pumps; W-317-B4, Vertical centrifugal pumps; W-450-B17A, Deep-well turbine pumps; W-450-B19, Deep-well turbine pumps; W-450-B22, Sump pumps.

Feeders. Hardinge Co., York, Pa.—Bulletin 33-C—12 pages on constant-weight feeders, volumetric feeders and disk feeders made by this company.

Filters. The Eimco Corp., Salt Lake City, Utah—Bulletin 400—15 pages, with engineering data, describing rotary vacuum filters made by this company.

Floats. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.—Bulletin 635—4 pages describing this company's welded steel (chromium plated) and stainless steel floats.

Heaters. J. O. Ross Engineering Corp., 350 Madison Ave., New York City—Bulletin 122—16 pages on direct and indirect oil- and gas-fired air heaters for industrial use.

Heat Transfer. Griscom-Russell Co., 285 Madison Ave., New York City—Form 495—4 pages on this company's heat transfer equipment for petroleum refineries.

Instruments. Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa.—Catalog TC—16-page manual on the control of time in connection with industrial processes.

Instruments. Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio—Bulletin 102—31 pages on this company's air operated instruments for combustion control.

Instruments. Cambridge Instrument Co., 45 Grosvenor Pl., London, S.W. 1, England—Folder 50—6 pages on this company's thermoelectric pyrometers and thermocouples for indicating and recording.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 535—4 pages on reducing electrical demand peaks by staggering loads.

Instruments. Mercoid Corp., 4201 Belmont Ave., Chicago, Ill.—Bulletin 6—4 pages describing the company's line of controls for refrigeration.

Instruments. Smoot Engineering Corp., 2240 Diversey Parkway, Chicago, Ill.—Data Book S-20—32 pages on the use of mechanical combustion control for boilers.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Catalog 1125—24 pages on a wide range of industrial thermometers made by this company.

Instruments. Taylor Instrument Cos., Rochester, N. Y.—Bulletin 37R—35-page book dealing with this company's new "Dubl-Response" control systems; first reviews the characteristics and limitations of various conventional controller types and then by means of numerous easily understood sketches explains the principles of the new system. Also discusses control problems and their solution in certain specific cases.

Insulation. Johns-Manville, 22 East 40th St., New York City—Bulletin IN-7A—64-page booklet describing a wide range of heat insulating materials made by this company and tabulating recommendations for specific services.

Lubrication. Alemite Corp., 1826 Diversey Parkway, Chicago, Ill.—25-page catalog on this company's power-gun lubrication equipment.

Materials Handling. Jeffrey Mfg. Co., Columbus, Ohio—Catalog 610—112 pages with descriptions and engineering data covering a wide variety of belt conveying equipment.

Materials Handling. Lewis-Shepard Co., Watertown Station, Boston, Mass.—Folder 311—Pictorial leaflet describing a wide range of moving, stacking and storing equipment.

Materials Handling. Palmer-Bee Co., Detroit, Mich.—Section 107, General Catalog 100—64-page catalog on screw conveying machinery with engineering data and comprehensive selection tables.

Metals and Alloys. Crucible Steel Co. of America, 405 Lexington Ave., New York City—General Catalog Section 1—95 pages on tool steels made by this company.

Metals and Alloys. International Nickel Co., 67 Wall St., New York City—Bulletin T-9—12 pages on this company's new heat treatable alloy, K Monel. Also Section 1 No. 5 of Nickel Cast Iron Data, 12 pages on application of nickel cast iron to petroleum production equipment.

Metals and Alloys. Latrobe Electric Steel Co., 40 West 40th St., New York City—19-page booklet and reprint completely describing this company's new method of metal cladding through the use of an electrochemical process combined with forge welding.

Metal Spraying. Metallizing Co. of America, 1218 Long Beach Ave., Los Angeles, Calif.—4 pages on metal spraying in general maintenance applications.

Microscopes. Bausch & Lomb Optical Co., Rochester, N. Y.—23 pages on this company's laboratory microscopes; 62-page catalog and price list on microscope accessories.

Mixing. Read Machinery Co., York, Pa.—Bulletin describing a complete line of industrial mixers for a wide variety of products.

Power Transmission. American Engineering Co., Philadelphia, Pa.—44-page catalog on Hele-Shaw fluid-power pumps, motors and transmissions.

Power Transmission. Gates Rubber Co., Denver, Colo.—Catalog DH-300—48-page catalog on this company's V-belt drives with complete tabulations of engineering data for facilitating selection; also 15-page price list on drives.

Power Transmission. E. F. Houghton & Co., 240 West Somerset St., Philadelphia, Pa.—6-page booklet on types of belt preservatives made by this company.

Power Transmission. Smith & Serrell, Globe Indemnity Bldg., Newark, N. J.—Bulletin 49—4 pages describing latest improved form of this company's Flexpin couplings.

Power Transmission. Vickers, Inc., 1460 Oakman Blvd., Detroit, Mich.—Bulletin 35-8—4 pages describing this company's hydraulic variable speed transmission.

Processes. Kansas City Testing Laboratory, 700 Baltimore Ave., Kansas City, Mo.—Bulletin 26—16 pages on patents and manufacturing formulae with a digest of patent procedure and a list of patented and unpatented processes available from this company.

Pumps. Lawrence Machine & Pump Corp., 371 Market St., Lawrence, Mass.—Bulletin 203—2 pages on pumps for chemical and acid service; Bulletin 204, 2 pages on high pressure, multi-stage centrifugal pumps.

Pumps. Lawrence Pump & Engine Co., Box 70, Lawrence, Mass.—6-page folder describing this company's double-suction, split-casing centrifugal pumps in capacities to 10,000 g.p.m.

Pumps. Quimby Pump Co., 340 Thomas St., Newark, N. J.—Bulletin C-112—4 pages describing this company's Quimby-Doty Type DB rubber-lined pumps for process use.

Pumps. T. Shriver & Co., Harrison, N. J.—Bulletin 101—4-page leaflet describing construction and use of this company's diaphragm pumps; Bulletin 102, performance reports on 53 units of this diaphragm pump in actual service.

Refractories. A. P. Green Fire Brick Co., Mexico, Mo.—12-page book commemorating this company's 25th anniversary, showing its history and production facilities, largely by means of photographs.

Refractories. Illinois Clay Products Co., Joliet, Ill.—Leaflet describing briefly products made by this company including fireclay brick and firecla y, and Therm-O-Flake, an exfoliated vermiculite produced in the form of granules, insulating cement, light-weight concrete and insulating brick.

Refractories. The Norton Co., Worcester, Mass.—6-page booklet describing this company's silicon carbide and fused alumina refractory brick.

Rubber Covering. Self-Vulcanizing Rubber Co., 605 West Washington Blvd., Chicago, Ill.—12-page booklet on "Sulfvulc," a self-vulcanizing rubber compound in paste or liquid form for producing rubber coverings on equipment.

Safety. Chicago Eye Shield Co., 2300 Warren Blvd., Chicago, Ill.—19-page catalog on protective equipment including goggles, masks, helmets and respirators.

Steam Storage. Foster Wheeler Corp., 165 Broadway, New York City—Bulletin R.A. 35-5—8 pages describing principles and application of the Ruths steam accumulator.

Sulphur. Freeport Sulphur Co., 122 East 42d St., New York City—Vol. 1, No. 1 of "Brimstone Brevities," an occasional periodical devoted to articles and references on sulphur, with particular reference to its applications in agriculture.

Valves. The Fairbanks Co., New York City—Catalog 21—52 pages on a wide range of valves and cocks made by this company; also covers unions.

Valves. The Lunkenheimer Co., Cincinnati, Ohio—Bulletin 504—8 pages on "King-Clip" gate valves.

Valves. Ohio Injector Co., Wadsworth, Ohio—8-page chart comparing this company's designations of a wide range of valves with those of other manufacturers.

Valves. William Powell Co., Cincinnati, Ohio—8-page booklet describing bronze, soldered-joint-end valves made by this company for use with streamline copper pipe.

Water Treatment. The Permutit Co., 330 West 42d St., New York City—30-page booklet reprinting a paper on mining, processing, manufacture and uses of zeolites for water softening.

Weight Control. Schaffer Poidometer Co., 2818 Smallman St., Pittsburgh, Pa.—Bulletin 6—28 pages describing this company's equipment for automatically feeding and weighing solid materials and for measuring liquids.

Welding. Air Reduction Sales Co., Lincoln Bldg., New York City—"Facts about Welded Piping," 24-pages on advantages and economics of this company's Airco method of pipe welding. Also leaflet describing this company's new portable tensile and bend testing machine.

Welding. Colmonoy, Inc., Box 977, Los Nietos, Calif.—Bulletin 40—15 pages describing the use of this company's products for producing wear-, corrosion- and heat-resisting surfaces on metals by hard facing.

Welding. Lincoln Electric Co., Cleveland, Ohio—16 pages on making equipment wear longer by hard facing; 8-page story and pictorial description of welding in construction work.

Chemical Engineering NEWS

Symposia on Program for Electrochemical Meeting

AMONG the highlights of the program which has been scheduled for the meeting of The Electrochemical Society, Inc., which will be held in Washington, Oct. 10-12, are the high temperature symposium and the session at which papers will be read on storage batteries and primary cells.

The high temperature symposium will be held on Thursday morning, Oct. 10. In dealing with high temperatures the electrochemist has been confronted with a number of serious problems such as a better source of high temperature; secondly, a higher melting refractory; thirdly, the interacting of materials without contaminating the product with objectionable impurities. At the coming symposium Dr. T. E. Sterne of Harvard will discourse briefly on possible upper limits in temperature far exceeding those of the outer layers of the sun, 6,000° K. Another paper will discuss the sun furnace utilizing a large, concave mirror bringing a vast quantity of sun energy to a focal point at which the crucible is placed. Temperatures of 3,000° C. are attained, making it possible to fuse zirconia without contamination by carbon.

On Friday morning, Oct. 11, storage batteries and primary cells will form the subject of discussion, with Dr. George W. Vinal presiding. In this field it is reported that there have been researches going on in all parts of the country and also abroad, and new, important developments have come forward. In the lead storage battery pure lead plates have been commercially possible, free from the objectionable antimony content, and free from stibine. Calcium has been found to be an advantageous addition to the lead of the grids. Finally, one company is bringing out an improved small-sized lead storage cell which is to replace the dry cell or Leclanché cell in many of the applications. Not to be outdone, the dry cell companies have come forward with a number of improved methods of manufacture and quality control. And, finally, the primary wet cell people have met the challenge from their side and have brought out an improved primary cell to be used in railroad signal service and the like. The battery symposium promises to be the most important session of its kind. Never before have the authorities in the various battery lines been assembled to discuss freely the pros and cons of the various types.

On Thursday evening the Edward Goodrich Acheson Medal will be presented to Frank J. Tone in recognition of Dr. Tone's outstanding accomplishments in electrothermics.

On Friday evening at the joint meeting of the scientific and technical associations of the Washington district, Dr. C. E. K. Mees, director of research, Eastman Kodak Laboratories at Rochester, N. Y., will be the guest speaker.

R.F.C. Grants Loan for New Kraft Mill

THE Reconstruction Finance Corporation in the latter part of August, granted a loan to the Crossett Lumber Co. of Crossett, Ark. The face of the loan was $3,850,000 and it was given as the result of an application by the lumber company for financial aid in the construction of a pulp and paper mill. The amount of the loan represents the estimated cost of the mill and it matures in instalments ending January 31, 1945. A brief opposing the loan had been filed by the American Pulp and Paper Association principally on the ground that current mill capacity in this branch of the paper industry was more than ample to take care of all consuming requirements.

In referring to the loan, Jesse H. Jones, chairman of RFC, said:

"The loan is for $3,850,000—estimated cost of the new mill—and matures in instalments ending January 31, 1945. The company's previous earning record, including the last few years, assures payment of the loan.

"The annual capacity of the new pulp and paper mill will be approximately 31,000 tons of kraft paper, and 15,500 tons of dried sulphate pulp, and we have been importing approximately 500,000 tons of kraft pulp annually.

"Construction of the Crossett mill will furnish a great deal of employment immediately, and continually thereafter in its operation.

"A brief filed by the American Pulp and Paper Association, opposing the loan, was given full consideration before the loan was granted.

"Every governmental loan to industry competes with private capital, and it is for Congress to determine how long it wishes such loans made."

Chemical Show Exhibits Point to Recovery

DIVERSITY and newness will be the keynotes of exhibits at the 15th Exposition of Chemical Industry, which is to be held during the week beginning December 2 at Grand Central Palace, New York. Diversity is the result of new emergence from the depression by every branch of the chemical and related industries into this recovery period, and newness is the summation of the research and development results which have been carried forward during the past five years. Not only the exhibits, but the classifications of attendance, will cover the complete range of the reconstruction period's industrial chemical interests. Appearing regularly during the past twenty years, under the same direction and with the same regulation of exhibit standards, the Chemical Exposition has an established attendance truly remarkable. Thousands of executives in charge of purchase, and administrative officials will attend this year to estimate the areas of competition and to compare the new offerings of the producers of machines and materials as a basis for contract purchase specifications. At the same time the development, research, operating, and engineering personnel will be sent by their companies to study, just as at a course of visual instruction, the newest advances of their own and competitive lines.

Executives responsible for the successful marketing of a new industrial product realize that their problem deals with every movement of the merchandise from completion of manufacture to possession by the final consumer, and in the case of many products, the complete and continual servicing in use. Meeting this need, the exposition will cover not only the field of raw materials and production machinery, but will have sections devoted to materials handling, packaging, bottling, labeling, up to the final marketing of chemical industrial products of every type. The plastics division will be more than ever complete and there will be a group of exhibits pertaining to the brewing and distilled spirit industries. Since chemistry and chemical engineering provide foundation and safeguards for the food and beverage industries, the exhibits of interest to these fields will be numerous.

DESILTING EIGHT BILLION GALLONS DAILY OF COLORADO RIVER WATER

WHAT will probably be the world's largest installation of continuous, mechanically-operated chemical engineering equipment has just been ordered by the Bureau of Reclamation of the U. S. Department of Interior for a great river desilting plant to be built on the Colorado River, 15 miles northeast of Yuma, Ariz., at the Imperial Dam, about 250 miles below Boulder Dam. A battery of 72 especially designed Dorr thickener mechanisms, each 125 ft. in diameter, will be used to remove between 50,000 and 70,000 tons of silt daily from an estimated flow of about eight billion gallons of river water. Clarified water will flow 210 miles through the All-American Canal to irrigate a million acres of arid land in California. The silt removed will be returned to the river below the diversion dam.

Behind this project, the contracts for which have just been awarded, lie six years of investigations, conducted jointly by the Reclamation Bureau's engineers and the research and development staff of the Dorr Co., both at the site on the Colorado River and at the Dorr experimental station, the Westport Mill, at Westport, Conn. At one point in the investigation 35 tons of Colorado River silt were shipped from Yuma, Ariz. to Westport, where for several months an experimental installation treated and retreated 3,600,000 gal. of water and 24 tons of solids a day under the conditions anticipated in practice. This semi-commercial scale work, 2,500 miles from the site of the proposed desilting plant, developed the basic engineering factors on which the final plant design was made.

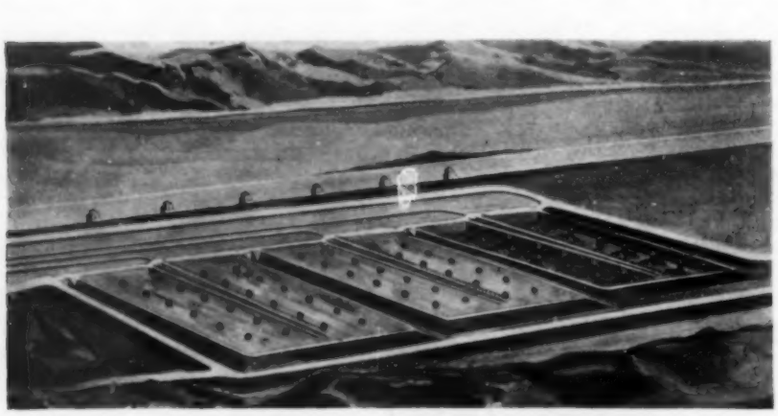
The desilting plant will consist of six settling basins, each approximately 769 ft. long, 269 ft. wide, with an average depth of 14 ft. These are arranged in pairs, each pair being fed by an influent channel, located between adjacent basins and these influent channels, in turn will receive their water from the headworks at the west end of the Imperial Diversion Dam where the rate of flow is to be controlled by four roller gates, each 75 ft. long and 23 ft. wide. The inflowing raw water will be uniformly distributed and will flow across the basins to the effluent side, depositing en route upon the bottoms of the basins the greater part of the suspended solids.

Because of its turbulence and rapid rate of flow, the Colorado River is able to carry with it in a buoyant state a tremendous quantity of silt. If the rate of flow were reduced as would be the case in the All-American Canal, the silt and earthy material would be deposited, thus necessitating costly continuous dredging operations throughout the entire length of the canal. Dredging operations of this type are common in the irrigation canals of the Imperial Valley in Southern California and cost the farmers about $1,400,000 annually. Consequently, continuous silt removal at the mouth of the All-American Canal has been decided upon and should readily liquidate its initial and operating cost through eliminating expensive dredging operations.

During periods of high turbidity the raw Colorado River water entering the desilting plant will contain 0.28 per cent of suspended silt by weight, equivalent to 90,000 tons of silt per day, in the estimated flow of 12,000 cu. ft. of water per second or 7.776 billion gal. per day. To prevent deposition in the canal, only the coarsest and heaviest—78 per cent of the silt coarser than 270 mesh standard screen—will be removed. This, it is estimated, will amount to about 70,000 tons per day and will be returned to the river below the canal intake.

A special feature of this installation of Dorr clarifiers will be the automatic, self-lifting and lowering plough blades so designed as to handle any short periods of overloading without requiring the attention of an operator. It is estimated that the power expenditure will not exceed 378 hp. and operating attention, in so far as Dorr clarifiers are concerned, is expected to be only nominal as they are being designed to run six months on a single application of lubricants.

The construction and operation of this project is under the jurisdiction of the Denver, Colo., office of the Federal Bureau of Reclamation, R. F. Walter, chief engineer, and J. L. Savage, chief designing engineer. The plans developed by the Reclamation Bureau engineers were reviewed by a board of consulting engineers consisting of Charles P. Berkey, Dr. W. F. Durand, and Dr. Louis C. Hill.



Artist's Sketch of World's Largest Water Purification Plant

A battery of 72 Dorr thickeners, each 125 ft. in diameter will remove 50,000 to 70,000 tons of silt daily from 8 billion gallons of Colorado River water for Imperial Valley irrigation project in California

Safety Congress Will Open Oct. 14

THE Twenty-fourth Annual Safety Congress and Exposition of the National Safety Council, Inc. will be held at Louisville, Oct. 14-18. The program calls for two morning sessions of the Chemical Section on Oct. 15 and 16 at the Brown Hotel.

The session on Oct. 15 will open with a message from the general chairman of the Section, A. L. Armstrong. Two papers will be read; one on "The Welding of Chromium Steels in Chemical Plant Equipment" by J. R. Dawson, research metallurgist, Union Carbide and Carbon Research Laboratories, Niagara Falls; the second on "Welding and Cutting in Tanks and Other Small Unventilated Places" by H. F. Reinhard, chemical engineer, Carbide and Carbon Chemicals Corp., New York.

H. L. Miner, manager Safety and Fire Protection Department, E. I. du Pont de Nemours & Co., Wilmington, will open the session on Oct. 16 with an address on "How Can Unsafe Practices and Unsafe Conditions Be Uncovered and Remedied." Election of officers will follow and then will come a round table discussion on "Safe Practices in Entering Tanks" under the direction of A. L. Armstrong, general supervisor of safety and fire protection, Eastman Kodak Co., Rochester, N. Y.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

WHERE will Washington take us next? This is the very logical inquiry frequently received at the Capital City by those who undertake to interpret Administration plans. The answer is not simple; but in one respect it is very definite. Washington has not fundamentally changed its plan or objective and the departure of Congress and the President's western travels will not significantly interrupt the reform efforts of the New Deal. These efforts will, however, take quite a new plan in the sense that administrative action, not legislation, is now to the fore.

Congress did substantially what the President asked throughout the longest session of recent years. It did not always act willingly; often it acted exactly contrary to clearly evident majority judgment. But the few defeats suffered by the President are negligible in economic, political, and social significance as compared with the tremendous number of victories. Speaking only of important measures one might say that the score was approximately 30 to 5 in favor of the President and in this game of politics the 5 men who did not score for the President remain on base until the second session comes when one heavy hitter of the New Deal is likely to bring them in so that for the 74th Congress as a whole the score is likely to approach 35 to 0.

The spectre of Supreme Court reversals still stands at the shoulder of the Administration and occasions certain nervousness. But certain ghost-laying power seems to have been found for Congress. It was utilized in the case of A.A.A. and T.V.A. amendments. In both cases past actions of the Administrative agencies were confirmed and "legalized" by definite Congressional action in such a manner that the New Dealers think the Court is powerless to reverse except on the ground that intrastate actions are being attempted. Excessive grant of power apparently cannot take place when the legislature confirms the Executive before the Court review can effectively function. How the Court will undertake to break up this alliance against the fundamentals of tri-part Government remains to be seen.

From the standpoint of process industry substantially the only defeat of the Administration which had large significance was the delay in enactment of the Walsh bill which proposed that any one having a contract with the Government must observe wage and hour standards prevalent under the Blue Eagle régime. Failure of the House to act on the revision of the food and drug law is not particularly significant because it represents merely a delay until next session. Likewise protection of the public purse by defeat of the bonus bill early in the Congress is merely a delay until election year shall make more than two-thirds of each house ready to override the expected further veto of the President. But in this case it is anticipated that the President will work out some form of compromise slightly less costly than the blanket payment proposed last spring.

During the recess Congress will continue to press a number of the legislative investigations which were not completed before adjournment. Approximately 15 major inquiries are scheduled, about equally divided between Senate and House. Those of greatest importance to process industry in the Senate are the lobby inquiry, munitions control investigation, wool marketing study, query on water utilization policies, and bankruptcy proceedings investigation. The House also will study lobby matters and its investigations will extend to chain store matters which indirectly affect all wholesaling policies because of the plan for restricting price minimums for quantity purchases. The House inquiry into patent pools may also materialize in a form significant for process industry.

Complete alcohol control is being resumed by the Treasury Department. Thus there is reestablished a close affiliation between industrial alcohol matters and beverage regulation, the industry hopes with definite benefit to industrial alcohol.

Negotiation of new trade agreements at the State Department progresses slowly. But even if the Department had completed some of these negotiations during the summer it is doubtful whether Secretary of State Hull would have ventured to announce them until Congress had left the capital. Of greatest concern to the chemical industries has been the pending negotiation with Canada. Apparently that was held up for some time during the summer through new requests from the Dominion authorities, which upset the series of tentative agreements reached during the late spring. But deep secrecy surrounds the plans and scope and there is little use in attempting forecasts on these subjects.

A Tariff Commission investigation of the cost of production of wood pulp was ordered by the Senate in the closing days of the past session.

Under a resolution introduced by Senator Borah of Idaho the Tariff Commission was directed to use the power it has in section 336 of the Tariff Act of 1930 to make the investigation. The Tariff Commission, under the authority in section 336, known as the flexible provisions of the tariff law, will decide from an investigation of the cost of production of wood pulp in this country and in the principal competing foreign countries whether or not the existing tariff on the product should be raised or lowered.

Federal Housing Administration has issued a booklet amplifying its policies regarding the eligibility of equipment and machinery for insured loans. In addition to equipment and machinery which becomes permanently attached to the real estate, FHA is now prepared to guarantee on a 20 per cent basis loans for movable equipment and machinery that meet the following general principles:

1. A unit value sufficient to justify time payments.
2. Useful life expectancy longer than term of credit.
3. Installation as part of a structure or business.
4. No hand tools, portable appliances, fragile articles, furniture unless built-in, removable decorations are eligible.
5. Replacement parts are eligible; repairs are not.
6. Appurtenances to eligible machinery are eligible, though physically separate, if usable only in connection therewith.

Maximum loan amounts are set at $50,000 for commercial buildings, manufacturing and industrial plants; $2,000 for domestic properties. A single borrower can apply for any number of separate properties, each of which is governed by the limitation set forth. The applicant need not be the owner of the property.

A study of the Italian picture with regard to war supplies reveals that there is not much chance that the United States stands to benefit from purchases which the government there might make.

Take chemicals first. The principal war chemicals are nitrogen, sulphur and possibly mercury. Italy is the second largest sulphur producing nation in the world. It is now producing nitrogen synthetically and is also a producer nation for mercury.

NEWS FROM ABROAD

By Special Correspondents of Chem. & Met. at London and Berlin

London

CHEMICAL markets are steady and appear to be little affected by the devaluation of the Belgian currency, while the gradual improvement in the basic industries is making itself increasingly felt. Rayon production has suffered a seasonal decline with the various smaller producing companies suffering from the effect of recent price reductions and trying to counterbalance these by interesting themselves in new types of fabrics and the production of knitted goods and dress materials. The possibilities of knitted fabrics are also cared for by firms of more recent date, some of which were established as the result of the imposition of import duties. One of these has made sufficient progress to warrant an increase in its share capital and as a result, Derby & Midland Mills Ltd., was incorporated recently, to amalgamate Derby Knitting Mills and Midland Dyers, the chairman of the new company being Dr. Herbert Levinstein, a director of the Cellulose Acetate Silk Co. The prospectus states that both the dyeing and knitting sections are making substantial profits, that the present output is fully sold ahead, and that additional plant and machinery is to be installed at the works at Derby.

It is announced that the hydrogenation plant of Imperial Chemical Industries at Billingham is working at capacity, an annual production of 50,000,000 imperial gal. being mentioned, and this together with other sources of home produced oils are stated to account for nearly 4 per cent of the total requirements of the United Kingdom. Incidentally and as previously mentioned, the Billingham hydrogenation plant, being a consumer of creosote oil, continues to influence its price, which still shows a slight upward tendency, whereas normally the price at this time of the year would show some decline. Considerable quantities of creosote are also exported to the United States.

Reference was also made during the parliamentary debates to the Stephenson process owned by Coal & Allied Industries Ltd. Mr. Stephenson's English Patent No. 431,063 was published July 25 and describes in some detail the general type of retort which is presumably being installed. It is a tubular retort internally heated, and slightly tapered to facilitate ejection of the solid residue and the essential feature is the preliminary mixing of the three parts of ground coal with one part of oil, and the intermittent injection into one end of the retort of the resulting paste, at a temperature of 325° C. and an initial pressure of 750 lb. per square inch. The retort is of nickel chome steel, and it is provided with hydraulic valves intermittently operated to release the volatiles for condensation. A catalyst which may be a zinc base or alkaline earth is added to the oil, and the final carbonizing temperature is between 500 and 600° C. Reference is made to the prior English Specification No. 324,443 of Cranston, covering a similar process in two stages and at a lower temperature and pressure. The shares of Coal & Allied Industries recently fell to about half their peak value, and it is reported that the building of the factory is proceeding rapidly and satisfactorily, and that a unit retort has been working there with success for the last three months.

The Imperial Magnesium Corp. has been formed under the auspices of I.C.I., Imperial Smelting Corp., British Aluminum Co. and the Magnesium Metal & Alloys, the nominal capital being £200,000. The object is evidently to take care of the future requirements of the aircraft industry and the various government departments, as well as the rapid expansion and use of magnesium in industry. It seems quite possible that ultimately certain international arrangements may be contemplated, seeing that British concerns have recently been active in research and patent development in this field. There has been some delay in the completion of the refinery of Herbert Green & Co. Ltd., which is exploiting the Duo Sol Solvent Refining process in this country. Production of lubricating oil is expected to begin in September, and judging by the stock market valuation of the company's shares, the prospects are regarded as favorable, in spite of the possibility of future competition.

English Patent No. 392,106 describes an improved machine for the manufacture of gilled pipes, and arrangements are contemplated for their manufacture. These pipes which are at present made in Switzerland and France, are claimed to give a heat transmission 21 per cent better than the spiral ribbed type. The circular disks are shrunk on to the central tube in the special machine and subsequently galvanized, the increased efficiency being apparently due to the improved and more permanent metallic content.

The building industry continues to flourish and the British Plaster Board Co. has acquired gypsum mines and other concerns suitable for concentration and rationalization in this industry; the profits are also expanding, although competition is keen and likely to increase. There is also considerable demand for reconstructed marble and terrazzo work, and there have recently been considerable improvements as regards color, permanence and finish. Hitherto research and development in this line has been conspicuous by its absence, and much greater progress has been made abroad. This state of affairs may soon be remedied, and the "Building Centre" in New Bond Street and the Building Products Research Association are likely to cooperate.

Berlin

BECAUSE of the present scarcity of raw materials in Germany, most of the reports read at the July meeting of German chemists at Koenigsberg dealt with substitution products; but many of them were nevertheless restricted to purely technical and scientific discoveries.

As against the production of illuminating gas from pit-coal, the preparation of that gas from other combustibles, like brown coals, is based upon fundamentally new methods, which Dr. Allner (Braunkohlen und Brikett—A. G. "Bubiag") demonstrated with his "Gleichstrom" chamber. In this chamber, contrary to the method used in the usual coal-gas oven, the gases, plus the resulting glowing coke, are transported downward in a continuous process, broken up and then led off from the bottom of the chamber together with the water gas which has been formed because of the introduction of steam to the coke column. This arrangement allows the generation of gas in one working cycle without the interference of intermediary products such as carbonization gases, water and tar. After the removal of ammonia, sulphur and carbon dioxide, the resulting gas differs from coal gas only in its carbonic acid content, which in the case of German brown coals varies from 14 per cent to 24 per cent. Subsequent washing with newly designed wash-towers and regenerators reduces the carbonic acid concentration to from five to six per cent. The product is then mixed with coal gas and ready for consumption.

Generation of such gas since October, 1934, has averaged from 5,000 to 7,000 cubic meters daily. Since most of the

bitumin of the coal is decomposed, the tar precipitate is very small in quantity (about 10 kg. per ton of coal). The benzol content of the resulting gas varies between 12-20 grams per cubic meter. The small plant at Kassel produces about 30-50 tons of benzol annually. The coke is used for heating the gas chambers and is produced at the rate of about 300-350 kg. per ton of coal. The carbonic acid can be converted into a perfectly odorless and tasteless dry ice. The unusual elasticity of the Gleichstrom process insures a uniform composition of the end products whether these be according to the methods of Fischer-Tropsh or those of the I. G. The economy of the Kassel process rests on the low prices of raw materials and the high percentage of gas extraction (A 7 per cent bitumin concentration produces 500-530 cubic meters; the mid-German brickets up to 800 cubic meters).

The Pintsch-Hillebrand water gas process, reported by Dr. Gerdes, of Berlin, is used in the case of highly reactive fuels like brown coals or peat, for which the usual apparatus is entirely unsuited. In this process the water gas is mixed with steam, the mixture pre-heated to about 1300 deg. C. and lead to the coal in the generator. However, if the heating in the generator is carried on, not by its own gas but by gas from an external source, the gas yield will increase from 1.2 to 1.3 cubic meters per kg. of bricket. This process is of great advantage in the Fischer syntheses because of the ease with which the maximum proportions of carbon monoxide and hydrogen (1:2) may be obtained, and also because during the syntheses the residual gases may be used for heating the regenerator so that expenditures per kg. of benzol are greatly reduced.

Because of its carbon activity and small surphur and phosphorus content, peat coke, produced from peat in closed retorts and heated by its own generated gases, is useful in metallurgical processes, particularly those of copper, steel and iron. It can be used also as motor fuel for automobile trucks. Mixed with gasoline in the proportion of 1-13 kg. peat coke to one liter gasoline, it reduces the price of such fuels about 25 per cent.

The removal of peat from large areas of German bogs, made profitable by the new peat coking process, will increase the useful agricultural land in Germany by about 10 per cent.

Rosin production from German forests has been increased about 100 per cent because of a new discovery by Prof. Hessenland, which includes treating the wounds of the trees with a chemical stimulant, such as 25 per cent HCl. The tree balsam is not affected by the treatment; and though the colophon obtained from the balsam may tend to crystallize, this tendency is easily averted.

Regulations to restrict the use of fats, as insurance against a scarcity in food supplies, have affected particularly the soap industries. The fat content of all soap not designed for toilet uses has been reduced considerably. Potato flour, used before the war as a filler for soft soap, but prohibited during the war because of its food value, is now introduced to the trade in a refined form under the name of "Special Industry Starch." Dr. Steinhoff of Berlin reported that it qualifies particularly in the manufacture of those soaps in which fats have heretofore been used extensively. Its use is extended also to cold-stirred soaps, refined soaps and soap powders. While this starch is a filler, it contains properties which actually improve the resulting soap: because of its colloidal nature the lathering and washing qualities of the product are greatly improved.

The possibility of producing plastic and fire-resisting ceramic materials from the oxides of aluminum, beryllium, zirconium, magnesium, thorium, etc., was demonstrated by Dr. Ryschkewitsch, of Frankfort A.M. They are not only fire resistant but air tight so that they may be used in highest temperatures, in vacuum or under any pressures. And being also extraordinarily resistant to chemicals, they are recommended for the manufacturer of crucibles, pyrometer tubes, ovens for certain glasses, insulation material for cathode tubes and other high-temperature electrical apparatus; and they may be used advantageously in connection with gas reactions and particularly with reducing gases.

H. Welsch, of Ludwigshafen, demonstrated the manufacture of a light building material from water and mucilage, whipped into a foam and mixed with cement (Bav. Patent DRP 421177). The new Iporit method (DRP 574739 and 588196) produces a simpler concrete but one very similar to normal Beton. Sulphonic acid is added to the slaking water to accelerate the foaming process and potassium silicate to maintain its stability. Any sand having a minimum of 70-80 per cent purity and containing no elements larger than 5-7 mm. are ecceptable.

Pulp and Paper Men Will Meet at Philadelphia

THE fall meeting of the Technical Association of the Pulp and Paper Industry will be held at Philadelphia on Wednesday, September 18 and at Atlantic City on Thursday, Friday and Saturday. Headquarters will be at the Pennsylvania Hotel in Philadelphia and at the Ambassador in the New Jersey resort.

On the first day the members will be guests of the Paper Makers Chemical Co. on a visit to the Experimental Station of the Hercules Powder Co. near Wilmington, Del. The following three days will be devoted to a technical program which is said to be particularly good. Dr. Karl T. Compton, president of the Massachusetts Institute of Technology will be the principal speaker.

Advanced Welding Course In Cleveland

BEGINNING August 26, a special five day course in welding engineering was given in Cleveland by the John Huntington Polytechnic Institute in cooperation with The Lincoln Electric Co. The course will be conducted once each month, except November, through May, 1936. The course will consist of day and evening sessions. Day sessions will be held at the plant of The Lincoln Electric Co., which has offered the facilities of its welding school under the direction of A. F. Davis, vice-president. Evening sessions at the John Huntington Polytechnic Institute will be devoted to lectures and discussions.

Consumption of Turpentine and Rosin in United States

(Combined gum and wood products)

	Turpentine (Bbl. 50 gal.)			Rosin (Bbl. 500 lb.)		
	1934–35	1933–34	1932–33	1934–35	1933–34	1932–33
Automobiles & Wagons	869	853	665	1,473	1,505	773
Chemicals & Pharmaceuticals	802	748	650	3,056	3,889	3,028
Foundries & Foundry Supplies	167	206	115	2,385	1,670	3,663
Linoleum & Floor Coverings	6	2	51	15,854	19,530	16,003
Matches	0	0	0	1,585	3,160	3,749
Oils & Greases	191	201	586	31,833	30,634	21,899
Paint, Varnish & Lacquer	51,725	51,365	45,604	176,000	168,640	121,240
Paper & Paper Size	43	29	33	337,000	329,940	261,000
Printing Ink	376	389	453	11,872	11,677	10,225
Sealing Wax, Pitch, Insulation & Plastics	632	605	725	16,115	11,519	11,559
Shipyards & Carshops	718	511	684	60	39	108
Shoe Polish	12,678	11,516	10,986	1,130	850	290
Soap	200	113	175	283,465	264,173	261,350
Other Industries	898	830	799	3,007	3,045	770
Industrial Reported[1]	69,305	67,388	61,526	884,835	841,271	714,657
Not Accounted For[2]	277,969	271,767	301,935	239,216	178,726	456,679
Apparent U. S. Consumption	347,274	339,155	363,461	1,124,051	1,019,995	1,171,336

[1]Compiled from reports by individual consumers for the calendar year. Since industrial consumption is fairly uniform throughout the year in most industries, no material error is involved in using these figures on the naval stores season basis. They will affect only the "Not Accounted For."

[2]Principally unreported distribution of turpentine through retailers who sell in small quantities to ultimate consumers, and of rosin for unreported industrial consumption, also for distribution through retailers who sell in small quantities to ultimate consumers.

SAN FRANCISCO ENTERTAINS AMERICAN CHEMICAL SOCIETY

By **PAUL D. V. MANNING**
Pacific Coast Editor, Chem. & Met.

SAN FRANCISCO had a fine time acting as host to the American Chemical Society Convention, the week of August 19. Almost 1,200 members and guests registered for the meetings. Twenty years had elapsed since the Society had convened in the Golden Gate city, and many of the members present at the 1935 convention had attended the one held there in 1915. Dr. Arthur Lachman was responsible for the organization and planning of both conventions. His ability along this line was amply demonstrated.

Professionally the convention ranked high. A symposium on the chemistry and technology of wines was followed by a trip through the famous Asti winery of the Italian Swiss Colony.

Biological chemists held an interesting symposium on vitamins and one on proteins and amino acids. Colloid chemists participated in a symposium on diffusion.

L. C. Snider and B. T. Brooks think that the United States is in imminent danger of a petroleum shortage. Their paper was scheduled to be given before the Division of Petroleum Chemistry. The prospect of hearing this paper attracted a large audience, many of whom, authorities in this field, were primed to take issue with the authors on their opinion as to the danger of petroleum shortage.

The paper was not read, neither author being present. This brought some unfavorable criticism because of the inflammatory nature of the title. The Petroleum Division was fortunate in hearing a very well given talk by Dr. Ulric B. Bray on "Propane Processes for Refining of Lubricating Oils." This was illustrated by actual demonstrations with liquid propane and followed two days later with a trip through the Union Oil Refinery at Oleum.

Under the leadership of Dr. H. K. Benson of the University of Washington, the Industrial Division held a symposium on wood as a raw material for chemical commodities. This session was well attended. D. H. Jackson gave some interesting data on production of refrigeration by high vacuum. By passing live steam at low pressures through small jets at velocities as high as 4,000 feet per second ice crystals were formed at the ends of the jets, though these jets were only a few inches in length. By such developments refrigeration will probably become a much more generally used tool for the process industries than it has been.

The sessions of the Division of Paint and Varnish Chemistry, held in part jointly with the Golden Gate Paint and Varnish Production Club under the chairmanship of P. D. Buckminister brought forth some interesting papers and discussions. H. J. Wing reported his investigation of the problem of making paints stick to zinc surfaces, showing that the formation of a thin coating of zinc formate is the cause of the failure. Studies on the behavior of glass were reported by John D. Ferry and George S. Parks of Stanford University who polymerized a cracking still gas component, isobutylene, to form polyisobutylene which seemingly acts similar to glass excepting in a temperature range at which its properties can be conveniently studied.

Sugar technologists were interested in the description of the Spreckels' continuous process for recovering sugar from molasses, a paper given by S. C. Meredith, E. T. Winslow and L. Lewon. This process is continuous and utilizes quick lime directly for recovering the sugar from beet molasses. The amount of lime as well as labor and power requirements are lower, as well as less equipment required when compared to the Steffen's process.

Dr. William A. Noyes was presented with the Priestley medal. His address "The Way Forward in Chemistry" bespoke for the application of scientific facts and methods and their interpretations to world problems.

Additional plant trips included visits to the Berkeley plant of Durkee Famous Foods, American Can Co., Continental Can Co., several fruit canneries, Owens Illinois Pacific Glass Co. The Catalyst, floating laboratory of the University of Washington, was inspected. The high light of all trips was the all day boat ride around San Francisco Bay and up the Sacramento River. On this trip the visitors had an opportunity of visiting the huge California-Hawaiian Sugar Refinery and the Oleum plant of the Union Oil Co.

Wide World Photos

Dr. Roger Adams (center) of the University of Illinois presenting the A.C.S. award in pure chemistry to Dr. Raymond M. Fuoss (right) of Brown University; and the Priestley Medal award to Dr. William A. Noyes of the University of Illinois for his work "The Way Forward in Chemistry"

Arthur D. Little, Inc., Willed to M.I.T.

ACCORDING to the terms of the will of the late Arthur D. Little, the controlling interest in the research firm of Arthur D. Little, Inc., located at Cambridge, Mass., has been left in trust for the benefit of the Massachusetts Institute of Technology.

The trustees, Francis R. Hart, president of the United Fruit Company; Horace S. Ford, treasurer of M. I. T., and Royal Little of Providence, a nephew of Dr. Little, are directed to develop a plan whereby the corporation may be administered to insure its continuance as an independent agency to benefit both industry and the institute.

NAMES *in the News*

D. F. JURGENSEN, JR., has resigned his position as research chemist with the Pure Oil Co. to join the staff of the U. S. Gypsum Co.

KARL M. HERSTEIN and FREDERICK KENNY have formed the firm of Kenny and Herstein in New York and are engaged in the field of consulting chemists.

CHAS. A. MACDONALD, who for over 12 years was with the General Chemical Co., has embarked on sales engineering. His firm, the MacDonald Engineering Co. is located in New York.

CHARLES E. KELLOGG has been appointed principal soil scientist and chief of the Soil Survey Division of the Bureau of Chemistry and Soils. He succeeds Dr. Curtis F. Marhut, who died August 25 at Harbin, Manchuria.

WALTER H. BRUCKNER, formerly connected with National Lead Co., Research Corp. and Crucible Steel Co. of America, is now employed at the U. S. Naval Research Laboratory, Anacostia, D. C.

CHARLES E. ENTEMANN, JR., is now connected with Ekroth Laboratories, Brooklyn, N. Y.

ERICH FETZ has joined the technical staff of Wilbur B. Driver Co., Newark, N. J.

W. H. VAUGHAN is now director of the State Engineering Experimental Station at Georgia Institute of Technology, Atlanta.

O. C. RALSTON has been appointed supervising chemical engineer of the Nonmetallic Minerals Experimental Station of the Bureau of Mines at New Brunswick, N. J. He succeeds Dr. E. P. Partridge, who resigned to become director of research of the Hall Laboratories, Pittsburgh.

THOMAS V. MICHAELIS, formerly with Pennie, Davis, Marvin & Edmonds has become associated in patent work at Washington with H. C. Parker.

WILLIAM D. RAMAGE is associated with W. H. Archer as consulting chemist with offices at San Francisco.

M. J. RATHBONE has been appointed general manager of manufacturing at the Baton Rouge refinery of the Standard Oil Co. of Louisiana. He succeeds H. H. Hewetson, who has been transferred to Toronto.

HARRY A. FABER has recently been appointed assistant sanitary engineer of the Chlorine Institute. He was formerly in the employ of Consolidated Water Co. of Utica, N. Y.

ALEXANDER L. FIELD, consulting engineer for Rustless Iron Corp., has been appointed professor of metallurgy at Carnegie Institute of Technology.

WALTER A. SCHMIDT, president of Western Precipitation Co., Los Angeles, has been elected a director of the American Chemical Society.

N. BEVERLY TUCKER, formerly a member of the faculty at Virginia Institute of Technology, has joined the research organization of Procter and Gamble at Glendale, Ohio.

W. W. SKINNER, assistant chief, Bureau of Chemistry and Soils, has been named chairman of the board of regents at the University of Maryland. Dr. Skinner has served the board as a member and as its secretary for 18 years.

R. P. ALLARD is now on the technical staff of the department of chemistry at Loyola University, Los Angeles.

T. CORDERO, formerly connected with Northam Warren Corp., is now employed on the chemical staff of United Drug Co. and is located at Boston, Mass.

HERMAN LAND, formerly connected with Michigan State Cement and the New York Port Authority, is now employed as a chemist by the Interborough Rapid Transit Co.

JAMES MCLAUREN, a graduate of the University of Edinburgh, Scotland, and recently associated with Dr. Harold C. Urey, is now connected with the U. S. Department of Agriculture, at Washington, D. C.

THOMAS F. CALLAHAN, formerly of the Palmer Gas and Products Corp., has joined Wishnick-Tumpeer, Inc.

OBITUARY

ARTHUR F. WILLIAMS, president of Williams Patent Crusher and Pulverizer Co., St. Louis, died August 21 following an illness of 18 months. Mr. Williams was 55 years old.

ALBERT C. LEHMAN, chairman of the board and founder of the original unit of the Blaw-Knox Co., died July 24 at his residence in Pittsburgh. He was 57 years old.

B. H. JOHNSON, assistant to the president of R. D. Wood Co., Philadelphia, died in Toronto, August 27.

B. W. TRAYLOR, vice-president of Traylor Engineering & Manufacturing Co., Allentown, Pa., died of a heart attack at Louisville, Ky., August 14.

PETER J. KRENTZ, vice-president of Buffalo Foundry & Machine Co., died of heart trouble at his home in Buffalo on August 16. He had been ill for several weeks.

LEWIS MARVIN DRAKE passed away July 16. He had been head of the laboratory carrying his name at Daytona Beach, Fla.

CALENDAR

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Atlantic City, Sept. 18-21.

ELECTROCHEMICAL SOCIETY, semi-annual meeting, Washington, D. C., Oct. 10-12.

NATIONAL SAFETY COUNCIL, INC. annual safety congress, Louisville, Ky., Oct. 14-18.

AMERICAN PETROLEUM INSTITUTE, annual meeting, Los Angeles, Nov. 11-14.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, Columbus, Ohio, Nov. 13-15.

INTERNATIONAL ACETYLENE ASSOCIATION, annual meeting, Cleveland, Nov. 12-15.

EXPOSITION OF CHEMICAL INDUSTRIES, New York, week of Dec. 2-7.

Chemical ECONOMICS

FROM production figures which are available, it is evident that there was less than seasonal recession in July in the activities of most of the industries which are associated with chemicals either as producers or consumers. Reports regarding production schedules for August also are of an encouraging nature and improvement over August is reported for the first half of the current month.

Shipments of rayon from producing points in August were larger than had been anticipated, in fact the movement from producers was said to have been heavier than in any month of this year with the exception of January.

Activities in the automotive industry held up well through the hot weather period and while the output in the next few months will be relatively light, tire makers have mapped out a large production schedule for the near future.

All branches of the textile industry have been operating on a fairly high plane in the last two months and have speeded up activities in the present month with a corresponding increase in takings of raw materials.

Manufacture of glass, especially window glass, has expanded considerably since the turn of the month. Figures for July output of plate glass showed an unusually large production for that time of year and the total for the first seven months of this year is far in excess of that for the like period of 1934.

Some of the large soap plants have been running on reduced schedules and this is still true in a few cases but full schedules are planned for the final quarter of the year.

Private estimates for consumption of raw silk place the total at slightly under the July figure of 44,166 bales. In August, 1934, the consumption figure was 36,427 bales. Heavy buying on hosiery account helped to bring up the total shipped in August.

September shipments of rayon also will be large as producers have their output sold ahead for that month and probably will be forced to make inroads on stocks in order to fill consuming requirements.

Consumption of crude rubber by manufacturers in the United States for the month of July amounted to 36,384 long tons, which compares with 36,623 long tons for June, 1935. July consumption shows a decrease of less than 1 per cent below June, but was 11.8 per cent above July, 1934, according to statistics released by the Rubber Manufacturers' Association. Consumption for July, 1934, was reported to be 32,553 (revised) long tons.

There was a sharp rise in superphosphate production in July, with output 30 per cent larger than in June and 45 per cent larger than in July, 1934, according to reports by acidulators to The National Fertilizer Association. This was the second consecutive month in which production was above the corresponding month of 1934, following five months in which the trend was downward. The increase over last year was particularly marked in the southern area, which reported a gain of 65 per cent as against a 34 per cent increase in the northern area. As a result of the upturn in July, total output in the January-July period of this year was slightly larger than in the first seven months of 1934. The gain was due entirely, however, to increased production in the northern area, as a 9.3 per cent decline occurred in the South.

The Department of Commerce has issued a report to the effect that exports of chemicals and related products were well maintained in the first half of this year with all major items except sulphur and some of the coal-tars and fertilizer materials registering substantial increases over the like totals for 1934.

Foreign sales of chemicals and allied products reached the value of $63,118,000 during the first six months of the year, an increase of more than 8 per cent compared with the first half of 1934, while imports of chemicals and allied products in the first half of 1935 were valued at $57,527,000.

Industrial chemicals, which include such products as acids, alcohols, calcium chloride, sodium compounds, etc., led the chemical export list during the first half of the year with foreign shipments valued at $11,754,000 compared with $10,411,000 for the same period last year, and shipments of industrial chemical specialties to foreign markets increased 6 per cent to $6,384,000.

Exports of fertilizers, however, declined from $5,960,000 in the first half of 1934 to $5,109,000, due largely to smaller shipments of nitrogenous materials.

Despite the weak export demand for turpentine, shipments of naval stores, gums and resins were valued at $7,773,000 during the first half of 1935 compared with $7,110,550 for the corresponding period of the preceding year.

Exports of paint products, which includes pigments, varnishes, etc., were valued at $7,861,000 compared with $6,222,000 for the first half of 1934, an increase of 19 per cent. The export demand for ready mixed paints has been especially good since the beginning of the year. Foreign shipments during the first six months were valued at $1,921,500, an increase of 22 per cent over the same period of 1934 when exports were valued at $1,575,600.

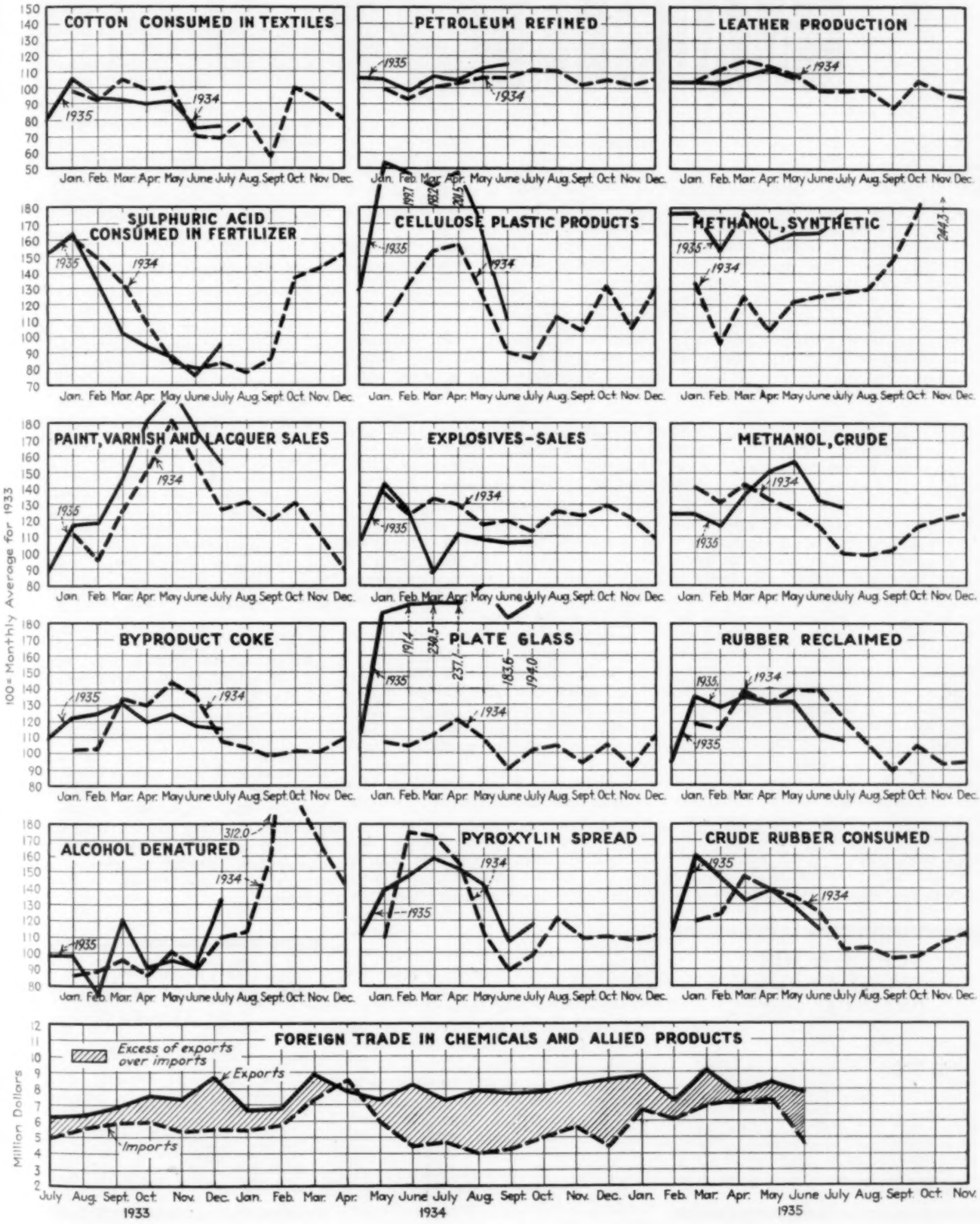
Sulphur exports declined both in quantity and value during the first half of the year—the quantity decreasing from 230,455 tons to 178,000 tons compared with the corresponding period of 1934, anl the value from $4,284,500 to $3,422,000. Sulphur exports during June, however, took a decided upward trend, increasing 40 per cent in quantity to 54,000 tons and 48 per cent in value to $1,049,000, compared with June of last year.

Production and Consumption Data for Chemical-Consuming Industries

	July 1935	July 1934	Jan.-July 1935	Jan.-July 1934	Gain Jan.-July 1935 over Jan.-July 1934 Per Cent
Production					
Alcohol, denatured, 1,000 wi. gal	8,192	6,731	43,298	40,312	7.4
Automobiles, No.	337,049	264,933	2,599,193	1,979,196	31.3
Byproduct coke, 1,000 tons	2,566	2,381	19,123	18,754	2.0
Glass containers, 1,000 gr.	3,579	3,117	21,908	20,717	5.7
Plate glass, 1,000, sq. ft.	13,909	7,242	102,273	55,131	85.5
Methanol, crude, gal.	331,437	256,136	2,429,266	2,285,528	6.3
Methanol, synthetic, gal.	1,278,505	939,439	8,580,316	6,101,783	40.6
Paperboard, 1,000 tons	260	202	1,830	1,602	14.2
Pyroxylin spread, 1,000 lb.	3,587	2,972	29,228	27,046	8.1
Rubber reclaimed, tons	8,421	9,446	68,635	69,728	1.6*
Steel barrels, No.	559,311	598,745	3,595,515	4,429,043	18.8*
Sulphuric acid in fertilizer trade, tons	110,249	88,049	924,872	824,105	12.2
Consumption					
Cotton, 1,000 bales	392	360	3,216	3,285	2.1*
Silk, bales	44,166	32,021	289,534	265,265	9.1
Explosives, sales, 1,000 lb.	22,189	23,384	151,517	167,282	9.4*
Paint, varnish, and lacquer, sales, $1,000	29,111	22,943	199,932	171,261	16.7
Sulphuric acid in fertilizer trade, tons	94,980	83,079	752,505	799,823	5.9*

*Per cent of decline.

TRENDS OF PRODUCTION AND CONSUMPTION


COTTON CONSUMED IN TEXTILES
PETROLEUM REFINED
LEATHER PRODUCTION
SULPHURIC ACID CONSUMED IN FERTILIZER
CELLULOSE PLASTIC PRODUCTS
METHANOL, SYNTHETIC
PAINT, VARNISH AND LACQUER SALES
EXPLOSIVES - SALES
METHANOL, CRUDE
BYPRODUCT COKE
PLATE GLASS
RUBBER RECLAIMED
ALCOHOL DENATURED
PYROXYLIN SPREAD
CRUDE RUBBER CONSUMED
FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
100 = Monthly Average for 1933
Million Dollars
Excess of exports over imports
Exports
Imports
1935
1934
1933
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.

The MARKETS

DIFFERENT branches of the textile industry have been quite active in ordering out chemicals for September delivery with the woolen mills particularly prominent. Other consuming industries also have increased their takings of raw materials since the first of the month and trade opinions incline to the view that summer business held up well and that moderate gains will be registered in the closing months of the year.

Basic chemicals have shown very little in the way of price changes. The greater part of production is passing into consumption against contracts which tends to act as a stabilizer of values. In most cases contract prices will hold good on deliveries over the remainder of the year and it is too early for any general buying in January forward positions. The weighted index number for the month represents a slight recession due very largely to the low priced levels which prevailed in the market for naval stores. The price tone, however, appears to be firm and while important chemicals may not advance in price in the immediate future, there is no reason to believe that any lowering in quotations will take place.

Market values for oils and fats were sharply higher as a result of last month's trading. The drop in production of lard and tallow has cut down offerings and has acted as a stimulant to price advances. On the other hand processing taxes have added to costs of vegetable oils and higher cables from primary markets have greatly strengthened China wood oil. By way of contrast, linseed oil has run counter to the general trend and is selling below the level quoted a month ago.

Rosin color standards are tentatively to be slightly modified for experimental purposes. This is the result of the recent conference held by the Food and Drug Administration in Washington to determine the wishes of the trade and the user industries. Evidence collected thus far indicates that a better color spacing may be feasible, but it is desired to try out the proposed changes in a tentative form before making any commitment. The Department officials are cooperating to this end. Trial specimens of the new standards will, therefore, be formulated and some months given to further field study before any final action is taken. When changes are made it is likely that the number of color standards will not be significantly reduced, certainly not in the light colored end of the series.

In connection with the recent attempt to unite producers of nitrogen, a report from our consul at Frankfort-on-Main states that negotiations for a World Nitrogen cartel having failed through the withdrawal of Chile, European synthetic producers have agreed to establish a new cartel to succeed the one which expired on June 30 with membership confined to themselves.

The new European Cartel thus restores the situation existing prior to July 1, 1934, with the European synthetic producers including Germany, England, Norway, France, Belgium, Poland, Czechoslovakia, Switzerland and Italy, organized as one group, and the Chilean nitrate industry independent, it was stated.

Chile's withdrawal from the Cartel is said to be due to the inability of that country to obtain satisfactory export quotas. The improved position of the Chilean nitrate industry as reflected by increased turnover, reduced stocks, economic concentration of production, etc., has greatly increased the financial and commercial competitiveness of that country in world markets, making it less disposed to grant concessions to their European rivals which produce nitrogen synthetically. A later press despatch said Chile had joined the nitrogen pact.

Among domestic developments is a report that a new non-flammable weed eradicator had been discovered by the University of Minnesota farm school experts. The basic chemical is said to be a byproduct of gas manufacture made by passing an electric current through a saturated solution of ammonium sulphate. After killing the weeds it is claimed that the compound disintegrates enriching the soil with nitrogen and sulphur.

From Italy comes a report that Royal Decree Law No. 1312, to extend the government subsidy to the Italian sulphur industry through 1935-36 and 1936-37 provides for an annual appropriation of 30,000,000 lire for the fiscal years 1935-36 and 1936-37 to meet any differences between the minimum prices for sulphur as guaranteed producers by the Sulphur Sales Office and the sales prices realized on the world market.

In the latter part of August it was announced that equipment was being installed in a plant at Springfield, Ill., for the purpose of crushing soya beans. At about the same time the U. S. Department of Agriculture issued a report which said that in less than 30 years the domestic soya bean acreage had increased from 50,000 acres to 5,000,000 acres—in fact the 1935 acreage is reported at 5,463,000 not including what was sown with corn and other crops for forage. The soya bean harvest in 1934 was 17,762,000 bu. Only about 20 per cent of the total crop is harvested for the oilseeds. In the first half of this year production of crude soya bean oil was 42,260,967 lb. compared with 14,692,499 lb. in the first half of 1934.

Factories in the United States used 20,907,000 lb. of soya bean oil in 1934. About half—10,451,000 lb.—went into the making of paint and varnish. The remainder was used as follows: compounds and vegetable shortenings, 2,735,000 lb.; other edible products, 533,000 lb.; soap, 1,354,000 lb.; linoleum and oilcloth 2,843,000 lb.; printing inks, 59,000 lb., miscellaneous products, 2,109,000 lb.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**87.35**
Last month	87.56
September, 1934	87.51
September, 1933	86.09

While major items in the chemical list held an unchanged position and some selections, such as metal salts, advanced in price, the weighted index number was lowered principally because of the lower level at which turpentine sold.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	**87.98**
Last month	85.10
September, 1934	68.65
September, 1933	56.70

Linseed sold off but China wood oil was sharply higher and most of the other vegetable oils were marked up in price. Tallow and animal fats also closed above the levels quoted a month ago.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Sept. 12.

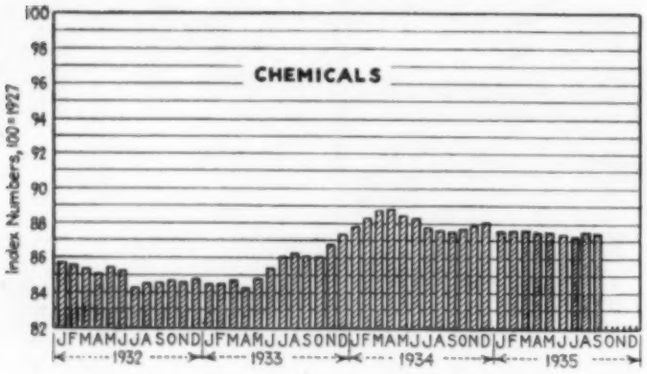
Industrial Chemicals

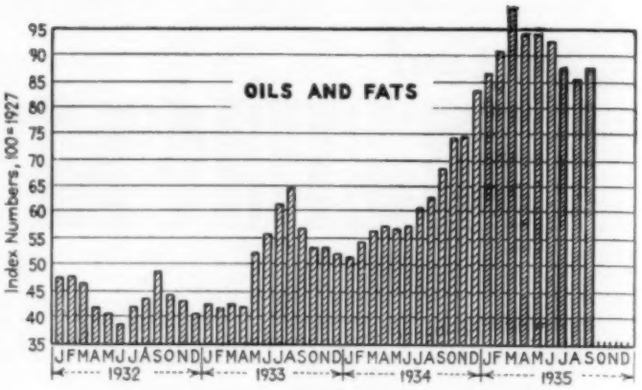
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.12 –$0.12½	$0.12 –$0.12½	$0.11 –$0.11½
Acid, acetic, 28%, bbl., cwt.	2.45 – 2.70	2.45 – 2.70	2.76 – 2.90
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	9.13 – 9.38
U. S. P. reagent	10.52 –10.77	10.52 –10.77	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	95.00 –105.00
Citric, kegs, lb.	.28 – .31	.28 – .31	.28 – .31
Formic, bbl., ton	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb.	.60 – .65	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.12 – .12½	.12 – .12½	.11½– .12
22%, tech., light, bbl., lb.	.06½– .07	.06½– .07	.06 – .06½
Muriatic, 18° tanks, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11½– .12½	.11½– .12½	.11½– .12½
Phosphoric, tech[1], c'bys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton	15.50 –.....	15.50 –.....	15.50 –.....
Tannic, tech., bbl., lb.	.23 – .35	.23 – .35	.23 – .35
Tartaric, powd., bbl., lb.	.24 – .25	.24 – .25	.25 – .26
Tungstic, bbl., lb.	1.50 – 1.60	1.50 – 1.60	1.40 – 1.50
Alcohol Amyl	–	–	–
From Pentane, tanks, lb.	.15 –.....	.15 –.....	.143–.....
Alcohol Butyl, tanks, lb.	.13 –.....	.13 –.....	.095–.....
Alcohol, Ethyl, 190 p'f., bbl., gal	4.27½–.....	4.27½–.....	4.15½–.....
Denatured, 190 proof			
No. 1 special, dr., gal.	.36 –.....	.36 –.....	.346–.....
No. 5, 188 proof, dr., gal.	.35½–.....	.35½–.....	.34 –.....
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chrome, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Potash, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com., bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Aqua ammonia, 26°, drums lb	.02½– .03	.02½– .03	.02½– .03
tanks, lb	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15½– .16	.15½– .16	.15½– .16
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.20 –.....	1.20 –.....	1.20 –.....
Amylacetate tech., tanks, lb.	.142–.....	.142–.....	.142–.....
Antimony Oxide, bbl., lb.	.11½– .12½	.10½– .12	.08½– .09
Arsenic, white, powd., bbl., lb.	.03½– .04	.03½– .04	.04 – .04½
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15 – .15½
Barium carbonate, bbl., ton	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	74.00 –75.00
Nitrate, cask, lb.	.08½– .09	.08½– .09	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.90 – 2.00	1.90 – 2.00	1.85 – 2.00
Borax, grain, bags, ton	44.00 –49.00	44.00 –49.00	40.00 –45.00
Bromine, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	2.10 –.....	2.10 –.....	2.50 –.....
Arsenate, dr., lb.	.06 – .07	.06 – .07	.05 – .06
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	20.00 –33.00	17.50 –.....
flake, dr., del., ton	22.00 –35.00	22.00 –35.00	19.50 –.....
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.00 –.....	2.00 –.....	.0185–.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.39 – 1.45	1.39 – 1.45	1.35 – 1.40
Copperas, bgs., f.o.b. wks., ton	14.00 –15.00	14.00 –15.00	14.00 –15.00
Copper carbonate, bbl., lb.	.08½– .16	.08½– .16	.08½– .16
Cyanide, tech., bbl., lb.	.37 – .38	.37 – .38	.37 – .38
Sulphate, bbl., cwt.	3.85 – 4.00	3.85 – 4.00	3.85 – 4.00
Cream of tartar, bbl., lb.	.16½ – .17	.16½– .17	.18½– .19
Diethylene glycol, dr., lb.	.16½– .20½	.16½– .20½	.14 – .16
Epsom salt, dom., tech., bbl., cwt	2.10 – 2.15	2.10 – 2.15	2.10 – 2.15
Imp., tech., bags, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Ethyl acetate, drums, lb.	.08½–.....	.08½–.....	.08½–.....
Formaldehyde, 40%, bbl., lb.	.06 – .07	.06 – .07	.06 – .07
Furfural, dr., contract, lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, crude, drums, gal.	.75 –.....	.75 –.....	.75 –.....
Refined, dr., gal.	1.25 – 1.30	1.25 – 1.30	1.25 – 1.30
Glauber's salt, bags, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Glycerine, c.p., drums, extra, lb.	.14 – .14½	.14 – .14½	.13½– .14
Lead:			
White, basic carbonate, dry casks, lb.	.06½–.....	.06½–.....	.06½–.....
White, basic sulphate, sck., lb.	.06 –.....	.06 –.....	.06 –.....
Red, dry, sck., lb.	.06½–.....	.06½–.....	.06½–.....
Lead acetate, white crys., bbl., lb.	.10½– .11	.10½– .11	.10½– .11
Lead arsenate, powd., bbl., lb.	.09 – .10	.09 – .10	.07 – .09
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, pwd., csk, lb.	.05½–.....	.05½–.....	.05½–.....
Lithophone, bags, lb.	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06– .06½
Methanol, 95%, tanks, gal.	.33 –.....	.33 –.....	.33 –.....
97%, tanks, gal.	.34 –.....	.34 –.....	.34 –.....
Synthetic, tanks, gal.	.35½–.....	.35½–.....	.35½–.....
Nickel salt, double, bbl., lb.	.12½– .13	.12½– .13	.11½– .12
Orange mineral, csk., lb.	.09½–.....	.09½–.....	.09½–.....
Phosphorus, red, cases, lb.	.44 – .45	.44 – .45	.44 – .45
Yellow, cases, lb.	.28 – .32	.28 – .32	.28 – .32
Potassium bichromate, casks, lb.	.07½– .08½	.07½– .08½	.07½– .08½
Carbonate, 80-85%, calc. csk., lb	.07 – .07½	.07 – .07½	.07 – .07½
Chlorate, powd., lb.	.08½– .09	.08½– .09	.09½– .10
Hydroxide (c'stic potash) dr., lb.	.06½– .06¾	.06½– .06¾	.07½– .08
Muriate, 80% bgs., ton	22.00 –.....	22.00 –.....	22.00 –.....
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.18 – .19	.18 – .19	.18 – .19
Sal ammoniac, white, casks, lb.	.04½– .05	.04½– .05	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –.....	1.23 –.....	1.23 –.....
Dense, bags, cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.85 – 2.00	1.85 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.05½– .06½	.05½– .06½	.05½– .06½
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	14.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.15½– .16	.15½– .16	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., lb.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	3.25 – 3.40	3.25 – 3.40	3.25 – 3.40
Nitrate, bags, cwt.	1.27½–.....	1.27½–.....	1.35 –.....
Nitrite, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb.	.023– .024	.023– 0.24	.02½– .023
Prussiate, yel. drums, lb.	.11½– .12	.11½– .12	.11½– .12
Silicate (40° dr.) wks. cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60-62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02¾	.02½ – .02¾	.02½– .02¾
Sulphur, crude at mine, bulk, ton	18.00 –.....	18.00 –.....	18.00 –.....
Chloride, dr., lb.	.03½– .04	.03½– .04	.03½– .04
Dioxide, cyl., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl. lb.	.55 –.....	.56 –.....	.56 –.....
Crystals, bbl., lb.	.39 –.....	.39 –.....	.38½–.....
Zinc chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05½– .06
Carbonate, bbl., lb.	.09½– .11	.09½– .11	.09½– .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.38 – .42
Dust, bbl., lb.	.066– .07	.063– .07	.07 – .07½
Zinc oxide, lead free, bag, lb.	.05½–.....	.05½–.....	.06½–.....
5% lead sulphate, bags, lb.	.05½–.....	.05½–.....	.06½–.....
Sulphate, bbl., cwt.	2.75 – 3.00	2.75 – 3.00	2.75 – 3.00

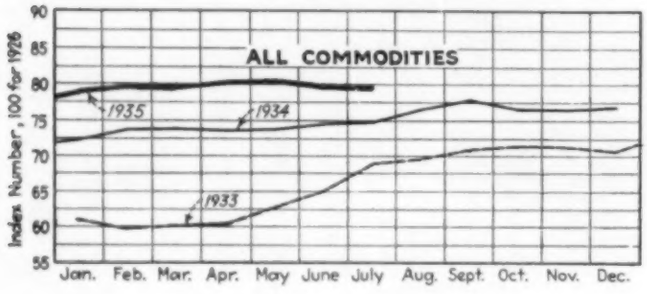
Oils and Fats

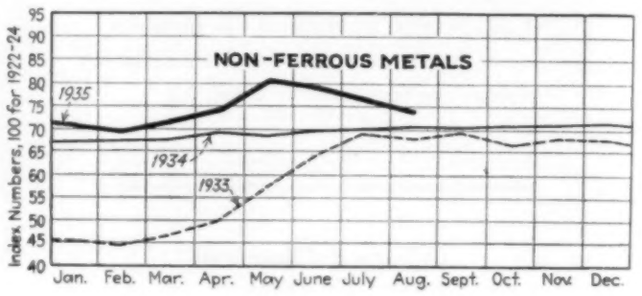
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½–$0.10	$0.09½–$0.10	$0.09½–$0.10
Chinawood oil, bbl., lb.	.22 –.....	.15½–.....	.099–.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.04 –.....	.03½–.....	.02½–.....
Corn oil crude, tanks, (f.o.b. mill), lb	.09½–.....	.08½–.....	.06½–.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.09 –.....	.08½–.....	.06½–.....
Linseed oil, raw car lots, bbl., lb.	.083–.....	.089–.....	.095–.....
Palm, casks, lb.	.04½–.....	.04½–.....	.03½–.....
Palm Kernel, bbl., lb.	.05½–.....	.05½–.....	.03½–.....
Peanut oil, crude, tanks (mill), lb.	.09½–.....	.08½–.....	.06½–.....
Rapeseed oil, refined, bbl., gal.	.45 – .46	.42 – .43	.38 – .39
Soya bean, tank, lb.	.08½–.....	.08 –.....	.06½–.....
Sulphur (olive foots), bbl., lb.	.08 –.....	.08 –.....	.07½–.....
Cod, Newfoundland, bbl., gal.	.35 –.....	.35 –.....	.40 –.....
Menhaden, light pressed, bbl., lb.	.065–.....	.065–.....	.053–.....
Crude, tanks (f.o.b. factory), gal.	.28 –.....	.28 –.....	.22 –.....
Grease, yellow, loose, lb.	.05½–.....	.04½–.....	.04½–.....
Oleo stearine, lb.	.12 –.....	.08½–.....	.08½–.....
Red oil, distilled, d.p. bbl., lb.	.09½–.....	.09½–.....	.07 –.....
Tallow, extra, loose, lb.	.06½–.....	.05½–.....	.04½–.....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90% tanks, works, gal.	.15 - .16	.15 - .16	.19 - .20
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.11 - .11½	.11 - .11½	.11- .11½
Cresylic acid, 97%, dr., wks., gal	.45 - .46	.42 - .43	.50 - .51
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.05½- .06½	.05½- .06½	.06 - .07
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	1.10 - 1.15
Resorcinal, tech., kegs, lb.	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal.	.26 -.....	.26 -.....	.26 -.....
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.30 -.....	.30 -.....	.30 -.....
Xylene, comm., tanks, gal.	.30 -.....	.30 -.....	.26 -....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.11 - .13	.10½- .13	.12 - .13
China clay, dom., f.o.b mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.04 - .20
Prussian blue, bbl., lb.	.36½- .38	.36½- .38	.35½- .37
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.80 - .85	.80 - .85	.80 - .85
Vermilion, English, bbl., lb.	1.52 - 1.55	1.52 - 1.55	1.58 - 1.60
Chrome yellow, C. P., bbl., lb.	.15 - .16	.15 - .15½	.15 - .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.09 - .10	.09 - .10	.06 - .08
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.15½- .16	.15½- .16	.16 - .16½
Kauri No. 1 cases, lb.	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b. N.Y.), ton.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton.	50.00 -.....	50.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.30 -.....	5.05 -.....	5.60 -.....
Turpentine, gal.	.44½-.....	.43 -.....	.46 -.....
Shellac, orange, fine, bags, lb.	.25 -.....	.25 -.....	.35 -.....
Bleached, bonedry, bags, lb.	.21 - .22	.21 - .22	.32 - .33
T. N. bags, lb.	.14- .15	.14 - .15	.26 - .27
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -....	13.75 -	13.75 -.....

INDUSTRIAL NOTES

THE BABCOCK & WILCOX CO., New York, has moved all of its divisions to 19 Rector St. but the general office of the company remains at 85 Liberty St.

ALLOY PRODUCTS CORP., Waukesha, Wis., has appointed R. W. Fuchs, 935 Drexel Ave., Drexel Hill, Pa., as its eastern representative.

GLOBE STEEL TUBES CO., Milwaukee, has appointed Avery & Saul Co., South Boston, distributors of its products in the New England territory.

ALSOP ENGINEERING CORP., New York, has appointed George E. Wilcox its representative in the Pittsburgh territory with offices at 1201 Metropolitan St.

MONSANTO CHEMICAL CO., St. Louis, has changed the name of its subsidiary the Swann Chemical Co. to the Monsanto Chemical Co. of Alabama.

ARNOLD WEISSELBERG, consultant on drying, process and mechanical engineering problems, has moved his office from Jersey City to 1071 Sixth Ave., New York.

REPUBLIC STEEL CORP., Youngstown, Ohio, has opened a sales office in the Dwight Bldg., Kansas City, Mo. Robert L. Pierce of the St. Louis office has been placed in charge of the new office.

IODINE CORP. OF AMERICA has been formed at Milwaukee to produce and distribute products containing iodine. Laboratory and office space has been acquired at 617 N. Second St.

THE KENNEDY VALVE MFG. CO. announces the appointment of O. R. Lane as its representative in Oklahoma, Arkansas, Tennessee, Eastern Missouri, and Southern Illinois and Indiana, with headquarters at 455 Paul Brown Bldg., St. Louis.

WISHNICK-TUMPEER, INC., has moved its New York office to 295 Madison Ave.

HANDY & HARMAN, New York are building a new plant in Toronto, Can. for melting, rolling, alloying, and refining gold and silver for the arts and industries.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1935	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$29,000	.....	$896,000	$371,000
Middle Atlantic	276,000	$68,000	2,991,000	2,102,000
South	207,000	75,000	8,305,000	5,559,000
Middle West	300,000	318,000	8,884,000	7,986,000
West of Mississippi	140,000	43,000	5,375,000	5,344,000
Far West	200,000	303,000	1,868,000	6,155,000
Canada	558,000	.....	12,403,000	1,320,000
Total	$1,710,000	$807,000	$40,722,000	$28,837,000

PROPOSED WORK
BIDS ASKED

Chemical Plant—McKesson & Robbins, Inc., Fairfield, Conn., will build a 2 story, 100x200 ft. addition to its chemical and drug manufacturing plant. Estimated cost $28,500.

Chemical Plant—Zenith Chemical Co., D. C. Dungan, Mgr., Salisbury, N. C., plans to rebuild chemical plant recently destroyed by fire. Estimated cost $28,500.

Distillery—Pan American Whiskey Distillers, L. J. Morris in charge, East Van Buren St., Phoenix, Ariz., has acquired the plant formerly occupied by Continental Packing Co. and will alter same for distillery. Estimated cost $100,000.

Distillery—Planters Distilling Co., Inc., P. Lester Hawks, Pres. & Gen. Mgr., Mt. Airy, N. C., and Charleston, S. C., contemplates the construction of a distillery at Charleston, S. C.

Factory—E. I. duPont de Nemours & Co., Inc., Buffalo Ave., Niagara Falls, N. Y., E. Fish in charge, is receiving bids for the construction of a factory.

Factory—National Cellulose Co., manufacturer of paper specialties, Baldwinsville, N. Y., and 366 5th Ave., New York, N. Y., has leased a factory building on Thompson Rd., Syracuse, N. Y., and will modernize and equip same for its own use. Estimated cost, $28,000.

Gas Plant—City, Webster City, Ia., J. A. Dunkel, City Mgr., plans to construct a municipal gas plant. Estimated cost $35,000. PWA grant applied for.

Gas Plant—Public Utilities Commission, J. W. Peart, Genl. Mgr., St. Thomas, Ont., Can., contemplates overhauling the city gas plant, mains and holders. Estimated cost $140,000.

Laboratory — Abbott Laboratories, 14th St. and Sheridan Rd., North Chicago, Ill., soon lets contract for the construction of a 2 story addition to their plant. Estimated cost including equipment $100,000.

Chemical Laboratory—College of the City of New York, 140th St. and Amsterdam Ave., New York, N. Y., plans extensions to its Chemical and Mechanical Arts Buildings. Estimated cost $50,000.

Research Laboratory — International Nickel Co., Inc., 277 Duke St., Montreal, Que., Can., plans to construct a research laboratory at Copper Cliff, Ont., Can. Estimated cost will exceed $40,000.

Bulk Oil Plant—Magnolia Oil Co., Brownsville, Tex., plans the construction of a receiving and storage plant for petroleum products with facilities for handling distribution. Estimated cost $75,000.

Oil Reclamation Plant — Canadian National R. R., Winnipeg, Man., Can., is receiving bids for constructing and equipping an oil reclamation plant.

Oil Refinery—Deseronto Refineries, Ltd., R. D. Perry, Pres. and Mgr., Deseronto, Ont., Can., is having plans prepared by A. Woodburn, 37 Silverbirch Ave., Toronto, for an oil refinery. The owners are interested immediately in prices of complete equipment. Estimated cost $100,000.

Oil Refinery—Mergraf Oil Refining Co., 3757 Bellevue Ave., Detroit, Mich., H. J. Holmes in charge, plans to construct a lubricating oil plant and distribution building in New York City or vicinity. Estimated cost $50,000.

Paint Factory—Acme White Lead & Color Works, 8250 St. Aubin Ave., Detroit, Mich., will construct an addition to its paint factory. Giffels & Vellet, 1000 Marquette Bldg., Detroit, Engrs. Estimated cost $50,000.

Paint Factory—Longview Paint & Varnish Co., 301 Bway., Kansas City, Mo., will construct an addition to its factory. Bids are now being received on general and separate contracts. C. B. Sloan, 9th St. and Baltimore Ave., Kansas City, Archt. Estimated cost $30,000.

Paper Mill—A. P. W. Paper Co., 1273 Bway., Albany, N. Y., will soon receive bids for altering its paper mill at North Albany, N. Y. Johnson & Wierck, Grand Central Terminal, New York, N. Y., archts. $120,000.

Paper Mill—J. P. Mechan & Co., Ltd., Vancouver, B. C., Can., plans to construct a pulp and paper mill at Squamish, B. C. Estimated cost $250,000.

Plywood Plant — Wheeler-Osgood Co., Tide Fla's, Tacoma, Wash., plans to repair and alter its plywood plant here. Estimated cost to exceed $100,000.

Soap Factory—General Soap Corp., 513 Peck Bldg., Grand Rapids, Mich., plans to alter its soap factory at Madison Ave. and 115th St., Cleveland, O. $50,000.

Tannery — Robert Scholze Tannery, 3000 Broad St., Chattanooga, Tenn., will build a 4 story, 80x150 ft. addition to tannery on St. Elmo St. Estimated cost $100,000.

Warehouse — Bernheim Distilling Co., 1701 West Breckenridge St., Louisville, Ky., will soon award the contract for the construction of a warehouse to have a capacity of 73,000 bbl.

Warehouses—Hiram Walker & Sons, Peoria, Ill., are having plans prepared by Smith, Hinchman & Grylls, Archts. and Engrs., Marquette Bldg., Detroit, Mich., for the construction of three rack warehouses. Estimated cost $100,000.

CONTRACTS AWARDED

Brass Factory—American Brass Mfg. Co., J. P. Arth, Secy.-Treas., 1525 East 49th St., Cleveland, O., awarded contract for 1 story top addition to its factory, to J. L. Schoeffel, 10425 Baltic Rd., Cleveland, O. $30,000.

Chemical Plant—Cincinnati Chemical Works, St. Bernard, O., awarded contract for addition to chemical plant to Panker Construction Co., 1030 Summer St., Cincinnati. Estimated cost exceeds $28,000.

Chemical Plant—Dow Chemical Co., Midland, Mich., awarded contract for addition to chemical plant, to Henry C. Webber Construction Co., Bay City, Mich. Estimated cost $60,000.

Chemical Laboratory—Mallinckrodt Chemical Works, 2nd and Mallinckrodt Sts., St. Louis, Mo., awarded contract for laboratory building to James Black Masonry & Contracting Co., Louderman Bldg., St. Louis.

Chemical Plant — Monsanto Chemical Co., 2nd St. and Lafayette Ave., St. Louis, Mo., awarded contract altering chemical plant building to Fruin-Colnon Contracting Co., 502 Merchants Laclede Bldg., St. Louis. Estimated cost $15,000.

Chemical Factory — Paramet Chemical Co., 10-17 44th Ave., Long Island City, N. Y., awarded contract for factory to Wheeling Construction Co., c/o Owner. Estimated cost $28,000.

Glass Factory—Pittsburgh Plate Glass Co., Barclay and Florida Sts., Milwaukee, Wis., awarded contract for remodeling two factory buildings, also constructing addition, to Hunzinger Construction Co., 1827 North 30th St., Milwaukee. Estimated cost $160,000.

Factory — Molybdenum Corp. of America, Washington, Pa., awarded contract for 1 story, 40x60 ft. factory to be used chiefly for extraction of lead, gold and silver ore shipped from Arizona to Holt, McConnel & Osborn, Inc., Cannonsburg, Pa. $40,000.

Pottery Plant—Harker Pottery Co., Chester, W. Va., awarded contract for kiln to Electric Furnace Co., Salem, O. $40,000.

Storage Building—W. J. Latchford Glass Co., 7507 Roseberry St., Florence, Calif., will construct a storage building. Work will be done by separate contracts and day labor. Estimated cost including equipment will exceed $28,000.

Storage Building — Stitzel Weller Distilling Co., Story Ave., Louisville, Ky., awarded contract for addition to its plant to be used for storage building to Combs Lumber Co., Lexington, Ky. Estimated cost $75,000.

Warehouse—Zellerbach Paper Co., 220 South Los Angeles St., Los Angeles, Calif., awarded contract for warehouse on South Evergreen St., to Austin Co. of California, 777 East Washington St., Los Angeles. Estimated cost $275,000.

INCREASE IN FACTORY CONSUMPTION OF OILS AND FATS

FACTORY consumption of oils, fats, and greases for the first half of this year has run considerably higher than it was in the corresponding period of last year, in fact higher than in the like period for the last five years. The tabular presentation which follows shows a total consumption of 3,665,437,000 lb. for the six-month period of 1935 and 3,284,122,000 lb. for the first half of 1934 or an increase of more than 11 per cent for the current year.

The totals include factory consumption of edible oils and fats as well as the inedible materials and the gain reported holds true for both branches.

An analysis of the tabulations reveals that consumption of crude vegetable oils was less this year than it had been in 1934 and 1933. This does not necessarily indicate a trend away from oils to competing materials although consumption of vegetable oils undoubtedly was reduced by the processing taxes which were in force. Consumption of crude oils includes the amounts taken by refiners and on that account there is a duplication of quantities for both production and consumption of refined and crude oils. As cottonseed oil is by far the most important of the oils, it follows that production and consumption of vegetable oils as a whole will fluctuate according to the size of the cotton crop or more precisely according to the amount of cottonseed which is available for crushing.

In contrast to the position of crude vegetable oils, consumption of refined oils was larger than in the comparative periods of the last five years. The diminishing supply and rising price trend for pure lard at the end of the period make it probable that the edible trades will continue to draw heavily upon refined oils although values for all oils have also been on a rising scale. In spite of a drop in production of crude cottonseed oil this year, consumption of refined cottonseed oil was 542,517,000 lb. in the first six months as compared with 505,940,000 lb. for the corresponding period of last year. The largest increase in consumption of refined oils this year, however, was in coconut oil, the total being 197,115,000 lb. this year and 150,337,000 lb. last year. The greater importance of soya bean oil is shown as home consumption of the refined product this year was 29,358,000 lb. compared with 4,515,000 lb. last year.

Factory consumption of crude vegetable oils for the half year finds declines in the case of cottonseed, coconut, corn, palm, and sunflower oils. In other oils increases were reported with peanut, soya, palm kernel, rapeseed, perilla, and sesame showing the largest percentages of gain.

As an offset to the decline in consumption of crude oils, a decided gain was reported for animal fats and greases. For a good part of the period animal fats were comparatively low priced. As a result consumption of inedible tallow this year was reported at 384,596,734 lb. as against 324,735,782 lb. in 1934 and 278,424,632 lb. in 1933.

Fish oils played a more important part in factory consumption totals this year, the six month total being 119,702,437 lb. with 81,270,274 lb. representing consumption for the comparable period of last year. There was a marked falling off in consumption of whale oil this year although a large increase in disappearance of hydrogenated oils is thought to have been partly due to large call for whale oil in that form.

In the accompanying table for factory consumption of oils, fats, and greases, the "Other products" include: lard compounds, hydrogenated oils, vegetable, and animal stearin, oleo oil, lard oil, tallow oil, fatty acids, red oil, stearic acid, glycerin, vegetable oil foots, and soap stock.

Consumption of Crude Oils

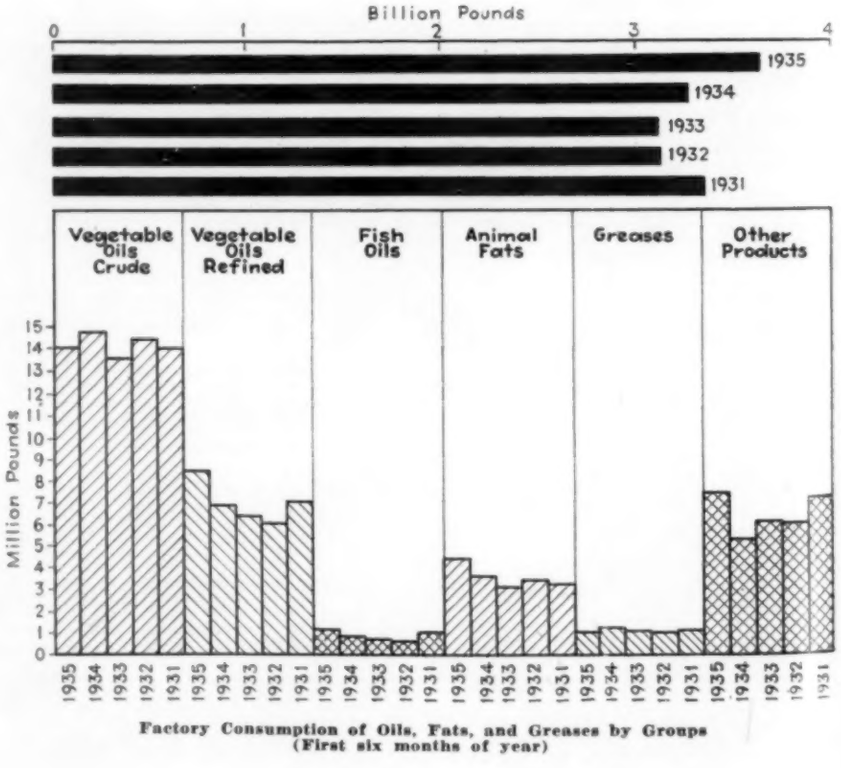
(First six months)

	1935 1,000 lb.	1934 1,000 lb.
Cottonseed	515,847	638,044
Peanut	54,163	5,294
Coconut	278,746	355,635
Corn	62,994	69,642
Soya	51,557	4,691
Olive, inedible	5,300	4,687
Olive foots	18,005	17,657
Palm kernel	25,783	9,088
Rapeseed	12,938	4,777
Linseed	142,264	141,901
China wood	61,705	56,003
Perilla	16,028	8,596
Castor	12,269	10,896
Palm	113,551	135,659
Sesame	14,935	6,731
Sunflower	4,805	10,776
Other	13,888	564
	1,404,778	1,480,641

Factory Consumption of Oils, Fats, and Greases

(First six months of years enumerated)

	1935 1,000 lb.	1934 1,000 lb.	1933 1,000 lb.	1932 1,000 lb.	1931 1,000 lb.
Vegetable oils, crude	1,404,776	1,480,640	1,362,949	1,447,903	1,404,414
Vegetable oils, refined	846,353	691,776	645,784	603,032	705,353
Fish oils	119,702	81,270	71,594	69,895	102,033
Animal fats	447,012	368,583	312,731	338,351	320,282
Greases	101,878	129,662	104,267	104,189	109,145
Other products	745,716	532,191	616,984	614,553	722,539
	3,665,437	3,284,122	3,114,309	3,177,923	3,363,766



Factory Consumption of Oils, Fats, and Greases by Groups
(First six months of year)